

OBSERVABLE EFFECTS OF ATTENTION, POSTURE, ERGONOMICS AND
MOVEMENT IN THE CLASSROOM

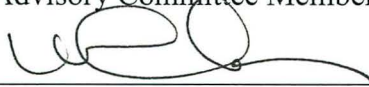
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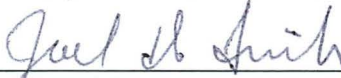
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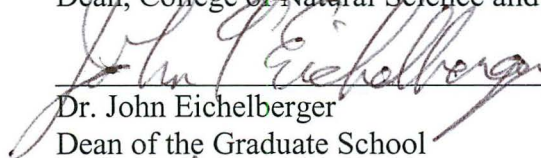


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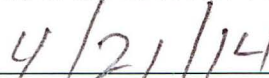
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OBSERVABLE EFFECTS OF ATTENTION, POSTURE, ERGONOMICS AND
MOVEMENT IN THE CLASSROOM

A
DISSERTATION

Presented to the Faculty
of the University of Alaska Fairbanks

in Partial Fulfillment of the Requirements
for the Degree of

DOCTOR OF PHILOSOPHY

By

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Abstract

Two studies related to student attention, posture, school ergonomics, student behavior (leaning, standing up, and moving), and learning engagement were conducted in Alaska. The Children's Postural Improvement Study (CPIS) looked at the observable effects of two interventions on attention. In the Classroom Environmental Study (CES) a baseline ergonomic survey compared observed student behavior and classroom arrangements.

The purpose of the CPIS was to investigate the effects of a postural education program, consisting of five 30-minute instructional sessions, as compared to a nutritional intervention at two elementary schools and its effect on attention. Three quantitative tools measured attention, the post-Partial Vanderbilt ADHD Teacher and Parent rating scales and pre- and post-math fluency tests. Qualitative measures included pre- and post-intervention photographs, daily comments from students after the lesson, and post open-ended-question student and teacher surveys. Based on the post-surveys, participants valued their good posture and made concentrated efforts to improve it. Quantitative results of this postural study revealed no correlation between posture and attention.

The follow-up CES examined the current state of furniture in 78 classrooms and pedagogical practices in regard to student movement and learning engagement in eight fourth-grade classrooms in three elementary schools. Two-way ANOVA revealed a significant school effect for leaning and significant classroom nested within school effects for leaning, standing up, and moving. Classroom sketches were coded to examine

movement and posture. No significant difference for desk clusters by grade, or by school using the Chi-squared test were found, but there was a significant difference comparing the seating relationship to instructional delivery by grade and by school.

Recommendations for future research and changes within Schools of Education and school districts to improve posture and learning engagement include: adjust current students' chairs and desks to meet their ergonomic needs; raise awareness of and inform pre-service, current teachers, students, and parents about ergonomic health concepts; encourage teachers to move around the classroom while instructing to engage students as they track the teacher's movement; and limit instructional periods to 20 minutes or less to allow for student movement breaks.

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Chapter 1 Introduction

Background

Teachers are facing more and more pressure to have their students succeed. Federal No Child Left Behind (NCLB) legislation require teachers to be highly qualified in the areas they teach and ties teacher evaluations and their jobs to students' meeting annual yearly progress in all areas (Hill & Barth, 2004). National, state, and local pressure requires teachers to use evidence- or research-based curriculums with fidelity to ensure student progress. Common Core Standards mandate what is taught and what needs to be mastered (J. D. Bell & Thatcher, 2012). In order to maintain their employment in these economically difficult times, teachers not only want but also need to ensure the best performance of all their students.

Unfortunately, some school districts approach this mandate from the wrong angle, thinking that more academic seat time and less recess time, or sometimes none at all, will help them succeed. Students need to be engaged in their learning and alert to absorb new information (Hancock, 2011; Silver, 2011). When the body is engaged and ready to learn or react to new information, it shows – the muscles are engaged and ready to move, as compared to a disengaged bored person, who is saggy or slouchy throughout their body. Teachers want students to be alert and engaged since student progress and in some cases the teachers' jobs depend on the student learning outcomes.

Human bodies were designed to move and, frankly, the education system has stifled that need. Ida Roth, an Alaska Native Elder, stated, "You have to move or you get stiff and die. You have to keep moving. . . I say no to retirement" (Roth, 2011). As Roth

(2011) stated, the body is meant to move; therefore, to expect children to maintain a static pose is unrealistic and in conflict with learning theory (Almarode & Almarode, 2008).

Todd (1937) recommended the same ergonomic principles used now for people and children who sit focused for extended periods: get up and move often if sitting; sit often if standing; look toward a distant horizon frequently; rotate your eyes and blink; and change not only your physical and visual focus but also your mental and emotional position frequently. This constant movement keeps your body performing at its best. Vernikos (2011) concurs that for an astronaut's body to recover its healthy physiology and reacclimatize to gravity, it must move frequently to stimulate nerves, muscles, and internal systems. Frequent movement and change of focus will help students maintain an alert and engaged mind and body. Humans are the only animals that can consciously change their behavior to the detriment of their body: sit for extended periods, hyper focus, and take on a slouchy posture. The origin of this study was to determine if human habits, postural alignment, can change and if the change, good posture, would produce positive results, such as improved attention. Can postural alignment be taught and will it help students be alert to instruction?

Student attention or learning engagement may improve with postural education and improved postural alignment. Students who are physically engaged in their learning through multiple learning styles (e.g. audio, visual, kinesthetic, interpersonal) have a stronger neurological connection to memory (Almarode & Almarode, 2008). To find an intervention that students and teachers will embrace and that has long-lasting health benefits is essential as these sedentary students, born after the creation of the Internet,

age. Students need to be challenged to believe in a healthier future. Spinal alignment allows for good musculoskeletal health: Nerve impulses, blood, and oxygen all flow freely as muscles are naturally toned to maintain core strength. A healthy student can engage in learning, pay attention to new concepts, learn facts and generalize this knowledge to new situations (E. P. Jensen, 2008; Obama, 2010; White House Task Force on Childhood Obesity, 2010).

An understanding of the complex structure of the spine, which is composed of 24 individually articulating vertebrae, is important. Vertebrae have three primary functions: bear body weight, anchor muscles and ligaments, and protect the spinal cord (White, 2000, p. 11). The 24 vertebrae have 155 points of articulation. Each vertebra articulates with the next vertebrae with four separate facets and with the inter-vertebral disc. The inter-vertebral disc is composed of the annulus fibrosus and the nucleus pulposus. These cartilaginous structures work together as a shock absorber to counter the effects of gravity, muscle strain, and weight bearing. Without this shock-absorbing mechanism, vertebrae would grind together, bone on bone, ultimately hindering human's bipedalism (upright walking on two feet). The vertebral column is capable of flexion (forward bend), extension (backward bend), lateral flexion (bending to both the right and the left), rotation, and a combination of all of these movements (W. D. Gardner & Osborne, 1978).

When the human spine is in correct postural alignment the body looks strong and capable similar to the anatomical drawings from Singer (1957). When it is misaligned it appears weak and collapsible (McAllister, 2009; Singer, 1957). In today's world, children may be more at risk for musculoskeletal discomfort due to spending more time with

sedentary activities, such as watching TV and sitting at computer stations which are not ergonomically designed (Dhara, Khaspuri, & Sau, 2009; E. Geldhof, De Clercq, De Bourdeaudhuij, & Cardon, 2007; Jacobs & Baker, 2002).

Need for the Study

Worldwide, a concern for children's back health is increasing. Many studies have shown an increased prevalence of back pain (American Academy of Orthopaedic Surgeons, 2008; Phélip, 1999; Widhe, 2001). Researchers have done measurements showing a change in the angle of the spine (Brink, Crous, Louw, Grimmer-Somers, & Schreve, 2009; Dolan & Green, 2006; Salminen, Erkinntalo, Pentti, Oksanen, & Kormanen, 1999). Pinpointing the cause of spinal pain or change in spinal structure is difficult since students are affected by a multitude of environmental factors.

Current research displays wide-ranging yet interconnected issues of lifestyle: nutrition, health, and technology; school environment: seating, technology, and backpacks; and social context: media, modeling, and mimicry (Bennett & Tien, 2003; Méndez & Gómez-Conesa, 2001; Robinson, 2011; Stellefson & Eddy, 2008). To fully understand the problem and find an attainable solution, one must analyze the components of each issue.

Possible causes of misalignment of the spine for young students in the school environment include the following: non-ergonomically designed furniture; increase of technology use; and heavy, improperly used backpacks and bags. Jacobs and Baker (2002) determined that computer use was causing musculoskeletal discomfort in children

similar to the level reported in adult literature. They also claim that children, who spend more and more time using computers, would be protected if they had ergonomically correct workstations that met their size needs (Jacobs & Baker, 2002).

A multitude of studies worldwide have shown that children do better in schools using ergonomically designed furniture because they are more comfortable (Aagaard & Storr-Paulsen, 1995; Chung & Wong, 2007; Gracia-Acosta, 2007; Jeong & Park, 1990; Savanur, Altekar, & De, 2007; Straker, Briggs, & Greig, 2002; Troussier et al., 1999; Wingrat & Exner, 2005). Furniture designers are not in agreement with all of the precise ergonomic measurements, but they do agree that if children are in desks and chairs that are adjusted to their height they will maintain better spinal health (Breithecker, 2011; Gale, 1997; Oregon State Dept. of Education, 2009; Savanur et al., 2007; C. D. Williams & Jacobs, 2002).

In a study of fourth-grade children in Maryland, researchers determined when children had chairs and desks that fit their height and size students attended to task more of the time and sat better (Wingrat & Exner, 2005). Although this finding is not a surprise, teachers are rarely given the luxury of choosing furniture that meets the needs of their students. It is not uncommon to walk into any classroom and find children unable to reach the floor with their feet because a chair is too big or to have their knees higher than their thighs because of a small chair. Some chairs and desks are adjustable but most are in a static, unmovable position. Research on the current local school environment and teaching practices may lead to a positive change for children's postural health, attention, or learning engagement.

Statement of the Problem

Children's posture is in a very unhealthy state. Inability to stand in balance with gravity is demonstrated when there is no longer equal distribution of weight along a plumb line, and students look uncomfortable. Now there are documented studies that measure the angle of the misalignment (Brink et al., 2009; Lafond, Descarreaux, Normand, & Harrison, 2007) and degeneration-type alterations of the spinal discs (Phélip, 1999). Children are spending more time not moving whether it be during the school day, using information technology devices, or at home watching TV, thereby not getting the strenuous exercise their bones and muscles need to remain healthy (Straker, Maslen, Burgess-Limerick, & Pollock, 2009; Straker & Mathiassen, 2009). This change in lifestyle impacts the human form in a slow process undetected until the medical response to a critical need. Tracy Roon, PT, and Theresa Sabbens, OTR/L therapists specializing in pediatrics, explained a new diagnostic medical condition – compartmentalization. It is a condition affecting babies, toddlers, and young children who spend too much time in carriers and not enough time on their stomach developing core muscles (T. Roon & T. Sabbens, personal communication, October 29, 2012).

What was once considered a given condition, having an aligned spine from birth through adulthood, has become a billion-dollar medical industry in the United States. Orthopedic surgeons warn of a shortage of qualified surgeons if this current trend of back-related health issues continue (American Academy of Orthopaedic Surgeons, 2008, p. ix). Many unexpected, unintended outcomes are being discovered through research on aging populations, which informs how the multidimensional issues of postural alignment

at home, school and play affects children through their lifetime. Defying gravity children learned how to walk, with an aligned spine, and maintain postural alignment throughout life until about the early 1900s when posture went out of fashion (Yosifon & Stearns, 1998). Poor posture in children can be attributed to many things, such as home lifestyle changes, school environment and social mimicry (E. Geldhof, Cardon, De Bourdeaudhuij, Danneels, et al., 2006; Kovacs et al., 2003; Kratenova, Zejglicova, Maly, & Filipova, 2007; National Safety Council, 2009; Straker, Burgess-Limerick, Pollock, & Maslen, 2009; C. D. Williams & Jacobs, 2002). The magnitude of this problem affects children's lifestyle, school environment, and social context; therefore, it will need a multifaceted solution.

Many children in Western society are plagued with back pain and disfigurement (Balagué, Dudler, & Nordin, 2003; Boćkowski et al., 2007; Brackley, Stevenson, & Selinger, 2009; Hollingworth, 1996; Mikkelsen et al., 2008; Phélip, 1999; K. D. Watson et al., 2002). In extreme cases, children have been observed with dowager's humps or hyperkyphosis, the hunching forward of the thoracic spine normally associated with old age, which is indicative of the premature fusing of the vertebrae. The spine is designed to move by maintaining its flexibility.

Back problems in later life can be linked back to the squirming, slumping, slouching, tipping, and rocking students do in search of some respite during a long school day (Boćkowski et al., 2007; G. M. Cardon, De Clercq, Geldhof, Verstraete, & De Bourdeaudhuij, 2007; Dolphens et al., 2011; Phélip, 1999). Students unintentionally break chairs when their discomfort and inability to find relief during required extended

seatwork has them tipping back on one or two chair legs. Back pain prior to 18 years of age is the leading indicator of adult back pain (Brattberg, 2004).

Introduction of the Studies Performed

Two separate studies were conducted, one providing an intervention and one observational only. The Children's Postural Improvement Study (CPIS) and the Classroom Environmental Study (CES) both took place in the Fairbanks North Star Borough in Alaska. Fairbanks is the second-largest city in Alaska with roughly 100,000 people in 7,361 square miles roughly the size of Connecticut and Rhode Island combined (1keydata.com, 2013; Fairbanks North Star Borough, 2011). The borough has 100,000 people, but the city itself has 30,000 or so. The Fairbanks North Star Borough school district operates 35 schools for approximately 14,300 students (Fairbanks North Star Borough School District, 2013). There are 13 private schools serving nearly 1,500 students in the same area (Private School Review, 2003 - 2013). The CPIS took place in two of the larger private schools of 120–250 students. The CES took place in three average-sized public elementary schools with enrollment of 400 to 525 students (Fairbanks North Star Borough School District, 2013).

Children's Postural Improvement Study (CPIS)

Purpose.

The purpose of the CPIS was twofold: first, to find an educational intervention that would help students and teachers achieve their goal of improved posture; and second,

to increase students' attention, often referred to as learning engagement. The goal was to choose an intervention with the potential to have a robust effect while not taking too much instructional time away from the teacher. The initial educational intervention instructed participants about the spine and how it functions best including demonstrations of how to bend, sit, stand and walk in spinal alignment with opportunities for participants to practice while getting feedback on their alignment. The long-term interventions involved visual representations, posters and a PowerPoint presentation, which voiced 16 affirmative spinal alignment messages (see Appendix A) matched with 16 models of children sitting in proper alignment. The messages were played at regular intervals throughout the day.

In the business world, it is a common practice for adult workers who spend up to 8 hours a day at a computer workstation to perform a self-assessment or obtain an outside ergonomic evaluation to prevent injury and save the company health care costs and work-time loss (American Academy of Orthopaedic Surgeons, 2008; Sigurdsson, Ring, Needham, Boscoe, & Silverman, 2011). In the school system, however, seating is based on cost, durability, and the ability to stack furniture out of the way. The cost of standard stacking chairs of 12" to 18" is \$36 to \$43, while the rocker chair costs around \$100. The cost of a two-student desk is \$172, and individual desk costs around \$100. A standing desk option costs \$125 (T. Doran, personal communication, September 18, 2012). At this point, there is no publicly expressed concern about possible injury or future pain of students who often use workstations that are ill fitted to their needs. This fact is grossly unacceptable (Harkness, Macfarlane, Silman, & McBeth, 2005; Schultz, 2003; Trevelyan

& Legg, 2011). The existing contributing factors to poor posture and learning engagement are multidimensional (see chapter 2). The CPIS converged on a few of these factors.

From an education viewpoint, a study in the classroom must be practical and appealing to the participants, including students with diverse abilities. The key to school-based research is a doable and inexpensive postural intervention that raises awareness for students and staff. Furthermore, the research encourages students to use their mind and body connection to enhance the learning experience. Students may realize improved postural alignment, which allows them to focus on the task at hand versus the nagging desire to move due to their discomfort that comes with stagnation (Sanford, 2006). The most pragmatic approach is to use a robust intervention that is replicable in any education setting.

Human research requires respect for research participants and limiting the amount of disruption from the ongoing educational program is vital. An awareness of the researcher's bias or advocacy lens must be taken into account (Breithecker, 2011; McNaught, 2001; Thompson, 2006). For example, I have an expectation that fundamental changes in classroom management and ergonomic seating could have a profound effect on the well-being of students.

In response to No Child Left Behind pressure and continuous requests to do research in the schools, the local public school district put in new administrative regulations safeguarding teachers' preparation time as it relates to proposed research. According to new draft district policy (see Appendix B) getting the necessary consent

and assent forms to conduct research could not impact teacher instructional time. Handing out and collecting letters, as well as tracking who has turned letters in and consented to the study, is time consuming. Thus, participant research in the public schools was now impossible.

I contacted local private schools immediately, in order to find an alternative study population. Of five schools contacted, two were willing to take part in this Children's Postural Improvement Study (CPIS). The original Institutional Review Board (IRB) approval for the study (Appendix C) had to be amended for the classrooms that were available at the private schools (Appendix D).

Research questions for Children's Postural Improvement Study.

The initial questions were:

1. To what extent does the postural or nutritional intervention improve posture?
2. To what extent does improved postural alignment improve attention in school-aged children?

Two questions came to the surface, as often happens in qualitative research:

1. To what extent do participants value posture and want to make a change?
2. To what extent does the intervention provide enough education for participants to change their postural alignment?

The i hypotheses tested to determine the answers to these questions were:

1. Posture does not change as a result of postural or nutritional interventions.
2. Attention does not change as a result of improved postural alignment.

The alternative hypotheses are that the interventions will improve posture, attention, and math fluency.

Classroom Environmental Study (CES)

Purpose.

The purpose of the CES was to obtain baseline data of what occurs in classrooms now: the average amount of leaning, allowable standing up and moving that students do during an observational period, seating options for students, and configurations of the classrooms. The intent of the CES was to determine to what extent ergonomics, posture, the classroom environment, and movement affect students' attention to task or learning engagement.

Learning engagement is defined as student involvement in a learning task (academic), ability to ask and answer topic-related questions (cognitive), physical manipulation of materials (behavioral), and enjoyment of the process (affective) (Beesley et al., 2010; Carter, Reschly, Lovelace, Appleton, & Thompson, 2012). Engagement basically means a pledge or obligation to fulfill usually done through attention to task. For this study, the aspect of learning engagement will mean students are paying attention, actively involved in their learning and enjoy the process (Beesley et al., 2010; Harcourt &

Keen, 2012). Veteran teachers, such as myself, can easily spot student engagement in behavioral terms: Students are alert, are focused on the task or not (attention) and can manipulate the activities, delivery and environment (Keen, Pennell, Muspratt, & Poed, 2011; Lunenburg & Irby, 2011). Teachers can vary stimuli by allowing movement, gesturing, focusing, different interaction styles, pausing, and changing sensory channels to improve the learning environment. Teachers can share nutrition of what to learn, provide complexity or depth of learning, and facilitate common bonds between peers to further discussion of ideas. They can provide choice of learning styles or preferences, reinforce the behaviors they foster, use multiple levels of questioning (initiating, probing and divergent), and value students by modeling genuine curiosity of a lifelong learner (Delisle, 2012; Lunenburg & Irby, 2011).

The purpose of the study was to determine the current state of the classroom furniture (ergonomics), whether the layout of the classroom lends itself to movement and how much and how often teachers allow physical movement in their classroom as part of the educational process. The economic feasibility of improving the classrooms' ergonomic seating is another consideration. Although this would not directly measure children's posture, it sets the groundwork for facilitating improved posture and improving learning engagement of students. It requires minimal classroom disruption and teacher time because the researcher would directly collect all of the data through observation.

Public school officials provided permission to use observational research that requires no consent of parents or assent from students. The basis for this research has a long history. Educational ethnography, observational research, was developed from the

practices of cultural anthropology (Creswell, 2008). The researcher observes the classroom or school culture and reports on the findings through data collection of behaviors and field note impressions of activities during the observational period.

IRB permission was granted to sketch the layout of each classroom in three public elementary schools (see Appendix E) and to spend three separate 1-hour observations in each of the fourth-grade classrooms in each school to track student leaning, standing up, and movement (Appendix F). The common American practice of starting to focus on academic content in the fourth-grade level informed this project. Education is focused on skill development during first through third grades, but at fourth grade students begin to use the basic skills of reading, writing, and math to explore content materials. Fourth grade is the beginning of independent work to master content knowledge and is often thought to be more sedentary as students study. In many schools, it also marks the end of outdoor recess three times per day meaning students increase the amount of available learning engagement time.

Researchers have found students spend much of their learning time in a static position (G. Cardon, De Clercq, De Bourdeaudhuij, & Breithecker, 2004; E. Geldhof, D. De Clercq, et al., 2007). One of the components of Finnish schools, regarded as the top in the world, is that students get plenty of exercise with 15-minute outdoor breaks after every lesson (Hancock, 2011). Taking away recess in hopes of better test scores in the United States may be counterproductive on several levels: Movement allows students time to make sense of new information, connecting it to past learning; positive student attitude increases learning; and engaging the whole child in the learning process is more

effective than the lecture model (Beesley et al., 2010; H. Gardner, 2011; Moley, Bandre, & George, 2011).

New programs in the United States are concerned with children spending too much time in a static position and encourage movement, nutrition and exercise (Girlshealth.gov, 2011; Kirk, 2006; NFL, 2011). Current brain research finds that movement breaks between lessons allow new concepts to be connected to previous knowledge as the brain works to make those connections (Almarode & Almarode, 2008; E. Jensen, 2005; Ratey & Hagerman, 2008; Templeton & Jensen, 1996). A simple change in the pre-service teacher education program can be implemented to incorporate ergonomic principles and strategies for learning engagement through movement. To determine the baseline data of the classroom environment, student posture and learning engagement is the next sequential step and could affect teacher pre-service education. (Doyle, 1979).

Ethnographic notes and data collection is imperative to the mixed methods approach, gaining the greatest amount of data during a limited amount of observational time. The research notes on the classroom activities during data collection of student engagement in leaning, standing up, and movement will illustrate whether the teacher allowed movement, encouraged or discouraged movement, or provided opportunities for individual movement or full class movement throughout the 1-hour observational period or throughout the day and why. The rationale for this study was to determine which of the multidimensional factors are in the classroom, which factors are absent, and which factors could be implemented without disrupting the educational process.

Research questions for Classroom Environmental Study.

The following research questions for the CES were addressed:

1. How much leaning, standing up and movement are allowed in the classroom during three 1-hour observations?
2. What ergonomic options are available to students?
3. To what extent does classroom layout lend itself to student movement?

The null hypothesis, “All schools will have similar levels of learning, standing, and moving and ergonomic options” was used to test expected distribution differences between the three schools.

Summary

This dissertation looks at both a CPIS, to improve posture and attention, and a CES, based on the findings of the CPIS, to determine if the current state of the classroom, the furniture, ergonomics, movement and posture affect learning engagement.

The next chapter, *Literature Review*, provides a review of the relevant literature in this relatively new field of study. Chapter 3, *Research Methodology*, explains how the mixed method theory was specifically applied to the CPIS and CES, the study measures, and the population of participants. Chapter 4, *Results*, presents the tabular, graphic and narrative form findings of both the CPIS and the CES. The final chapter, *Discussion and*

Conclusions presents the interpretations, conclusions, recommendations and suggestions for future studies.

Definition of Key Terms

Attention deficit hyperactive disorder (ADHD): ADHD is characterized by an inability to focus and is often associated with starting many activities and finishing none.

Annulus fibrosus: Outer fibrous cartilaginous concentric rings of the intervertebral disk.

Applomb: French for *Plumb line*: A string line with a weight suspended at the end to determine verticality; it creates a line directed to the earth's center of gravity.

Bipedalism: Walking or standing on two feet.

Cervical vertebrae: Top seven vertebrae of the vertebral column associated with the neck (White, 2000)

Core: The central part of the body including the stabilizing muscles of the low back pelvic and abdomen.

Ergonomics: Designing safe and efficient workspaces to reduce injury.

Extension (Spine): Backward bend

Fascia: Connective tissue binding the body structures together.

Flexion (Spine): Forward bend

Ilium: Blade-like feature of the pelvis

Ischium: Sitting bones located at posteroinferior part of the os coxae.

Intervertebral disk: Fibrocartilage cushions separating each vertebra (W. D. Gardner & Osborne, 1978).

Hyper kyphosis: Increase in anterior bend or hunching forward (H. Gappert-Hocchalter, personal communication, August 17, 2011).

Hypo kyphosis: Decrease or loss of the normal spinal curve in the thoracic region (H. Gappert-Hocchalter, personal communication, August 17, 2011).

Hyper lordosis: Increase in posterior bend or sway back of the lumbar vertebrae (H. Gappert-Hocchalter, personal communication, August 17, 2011).

Hypo lordosis: Loss of natural curve to an anterior bend often caused by slouching down resting on the lumbar vertebrae vs. the sitting bones (H. Gappert-Hocchalter, personal communication, August 17, 2011).

Kyphosis: Natural curve of the thoracic and sacral spine (H. Gappert-Hocchalter, personal communication, August 17, 2011).

Lateral flexion (Spine): Bending to the right or the left.

Learning engagement: Involved instructional or knowledge acquiring activities.

Lordosis: Natural inward curvature of part of the lumbar and cervical vertebrae (White, 2000).

Lumbar vertebra: The five vertebrae at the base of the vertebral column just above the sacrum and below the thoracic vertebrae, commonly called the low back (White, 2000).

Midsagittal plane: The midline which “divides the body into symmetrical right and left halves” (White, 2000).

Moving classroom: A classroom management technique that allows students to move and work with a variety of partners.

Nucleus pulposus: Pulpy cartilaginous tissue at the center of the intervertebral disk that acts as a shock absorber (W. D. Gardner & Osborne, 1978)

Optical flow: Patterns of approaching or receding circles of light, which simulate spatial organization of outdoor settings.

Os coxae or Innominate: Part of the bony pelvis made up of the ilium, ischium, and pubis (White, 2000).

Postural alignment: When there is a straight line from the head (ear), through the neck, shoulder, hip, and knee to the ankle that is plumb.

Postural hygiene: The science that is concerned with the preservation and maintenance of spinal health (Online Etymology Dictionary, 2011).

Postural misalignment: When a line from the head through the neck, shoulder, hip, and knee to the ankle is not plumb.

Pubis: The bony structure and midline point of and where the two os coxae meet and are attached by a fibrocartilaginous disk.

Sacral vertebrae (Sacrum): A wedge-shaped bone at the base of vertebral column made up of four to six (usually five) vertebrae which have fused together (White, 2000). Serves as a keystone between the two os coxae and bears the weight of the vertebral column.

Scoliosis: Side-to-side spinal curvature (H. Gappert-Hocchalter, personal communication, August 17, 2011).

Teacher directed full class movement (FCM): Movement the teacher initiates that directs all students from one area of the classroom to another area.

Thoracic vertebra: The 12 vertebrae located between the 7 cervical and 5 lumbar vertebrae (White, 2000).

Chapter 2 Literature Review

Introduction

The purpose of the Children's Postural Improvement Study (CPIS) and the Classroom Environmental Study (CES) is to determine what multidimensional interventions can be implemented in the classroom to improve children's posture and improve their attention to task, referred to as learning engagement. Further, the purpose is to determine the current state of ergonomics, movement, and learning engagement or attention in the classroom.

This chapter reviews the research literature as it relates to the elements of these studies. First, a retrospection of the historical context is essential to see how practitioners raised health concerns before the need for orthopedic surgeons increased and as people changed their lifestyles. Second, the current state of children's posture worldwide as it relates to an overall change in health is reexamined. Next, the effects of postural misalignment and how adolescent habits cause problems in adulthood are examined. Recent back education interventions and their effectiveness are surveyed. Studies that measured the student spinal misalignments in the school environment are reviewed. How posture affects learning engagement and attention is investigated. A summary of the literature review will conclude this chapter.

Historical Context

The inception of this study began with a personal quest for improved health that included postural alignment. My initial simple solution has become the theoretical framework for this study. The Human Potential Movement believes overall physical and psychological health is developed through the awareness of the mind and body connection. Many leaders in the human potential field began publishing their work in the 1960s – and 1970s (I. Rolf, 1978). Noelle Perez-Christiaens has a strong following of students who attend her B.K.S. Iyengar Institute in Paris, France to study *aplomb* (French for *alignment*). Jean Couch, one of her students, started a similar school in California called the Balance Center. Kay Hackney’s Interior Yoga provided the same postural alignment instruction here in Alaska. All three of these yoga-based centers encourage their students to focus their mind on the weightlessness of postural alignment, or making that mind-body connection to improve health.

Matthew Sanford, who uses a wheelchair for mobility, teaches his students with disabilities the feelings of yoga poses even though they cannot physically attain the poses. He instructs students to focus on the energetic connectivity versus the damaged nerve connections his paraplegic and quadriplegic students experience (Sanford, 2006). Rolf’s sensory integration of the fascia tissue led Mary Bond to write *The New Rules of Posture* (2007). More recently the work of Joan Vernikos (2011), the Director of NASA’s Life Sciences Division, explores the effects of gravity deprivation on astronauts and methods by which they might reclaim musculoskeletal strength upon return to earth. Using this common framework of mind and body connections and the recently published

research studies related to posture, the study focused on how postural alignment affects school-age children's learning engagement.

Noelle Perez-Christiaens has spent more than 40 years doing ethnographic studies of people's posture. Forms of postural alignment were present in museums artifacts and art from ancient times up to the early 1900's as well as being observed in cultures that continue to do physical labor daily. People in the Western world have misaligned hips, necks jutting forward, and backs hunching up due to their sedentary lifestyle (Yosifon & Stearns, 1998). The people who maintain postural alignment have had to do so for survival, often carrying food and water long distances. Many do hard physical labor into their 80s and 90s without back pain or stooped posture (Perez-Christiaens, 1982a, 1982b). When the spine is in postural alignment, the intervertebral disks act as shock absorbers counteracting the pressure of gravity (W. D. Gardner & Osborne, 1978).

Amazed by the spinal strength of women in Africa, a collaborative research team looked at the metabolic cost of bearing weight on the head in a collaborative quantitative study (Maloiy, Heglund, Prager, Cavagna, & Taylor, 1986). This study found that African women could carry 20% of their body mass without any metabolic cost. When the body is in postural alignment, the women are able to easily support weight. In fact, Maloiy et al. (1986) reported women commonly carrying up to 70% of their body mass on their heads. They noted no change in stride frequency, although their oxygen intake increased with heavier loads. The researchers could not figure out why these women were so efficient and attributed it to a possible anatomical change from carrying heavy loads

since childhood and not to the maintenance of spinal alignment, which naturally provides this strength.

Rolf (1978) provides another missing link to this fascinating puzzle by focusing on realigning the fascia with her structural integration theory. The body becomes more fluid and free-moving with gravity when the blockages in the fascia are unlocked. Bond, a student of Rolf's and the author of *The New Rules of Posture* (2007), describes posture as a dynamic activity. Using the model of "system tensegrity" invented by Buckminster Fuller, Bond explains, "it is the tensional force of our softer tissues (fascia) that keeps us erect, not the compressional strength of our bones . . . maintaining an upright stance is a process of perpetual motion" (Bond, 2007). Asking students to remain seated for extended periods may be detrimental to their posture by causing blockages in their fascia.

The body's ability to disconnect from severe pain, as described by Sanford (2006) in his book *Waking*, may be similar to the body disconnecting during 8 hours of working in a static position. Workers who are focused on work-related tasks while not attending to how their body is functioning rarely realize their body needs periodic movement. Prolonged sedentary behavior is similar to astronauts living without the benefit of gravity (Vernikos, 2011). Vernikos explains that Gravity Deprivation Syndrome (GDS) is the loss of bone density and muscle tone, what an astronaut experiences when in zero gravity. She explains that in our 20s we begin to lose 1% of our bone mass per year, and this is accelerated for the astronauts, who loses 1% of their bone mass for every month in space. Some of the characteristics for living without gravity, similar to someone who sits all day, are heaviness, spine compression causing back pain, slower heartbeat, a decrease in

stamina and strength, muscles that do not support bones, and trouble with coordination and balance. Characteristics are similar to those found in elderly people, many of whom have very fragile bones due to the lack of interaction with gravity or a sedentary lifestyle (American Academy of Orthopaedic Surgeons, 2008; Cenciarini, Loughlin, Sparto, & Redfern, 2010). The good news is that the effects of zero gravity can be reduced by exercise, getting up and down, and engaging with gravity (Vernikos, 2011).

One common thread of my CPIS is the basic connection to mindfulness of posture or being self-aware. Sanford, Rolf and Bond discovered their postural alignment internally through the subtle body, a combination of physical, mindful, emotional, spiritual, and energetic connections within the body (Bond, 2007; I. P. Rolf, 1977; Sanford, 2006). The ability of paraplegic and quadriplegics to feel the pose on many levels regardless of physically attaining the pose demonstrates the power of the mind and body connection. Perez-Christiaens', Couch's and Hackney's ability to visually recognize the difference between postural alignment and misalignment, discovered through ethnographic observation, was their first step in reclaiming their postural alignment and is the basis for their instruction (Perez-Christiaens, 1982b). This mechanical approach is easy to teach by superimposing a plumb line on pictures, and students easily see the difference between alignment and misalignment. Maintaining postural alignment from observations is difficult without developing the core strength to support the spine.

The following Literature Review presents the many components needed to make a significant change in postural misalignment, a long-ingrained habit. First, the magnitude

of the problem in the United States and the world will be described as the basis for this study. The key components in the current but limited research on spinal misalignment, attention to task and learning engagement, are closely related. Current research displays wide-ranging yet interconnected issues of lifestyle: nutrition, health, and technology; school environment: seating, technology, and backpacks; and social context: media, modeling, and mimicry (Bennett & Tien, 2003; Méndez & Gómez-Conesa, 2001; Robinson, 2011; Stellefson & Eddy, 2008). Each issue and its components must be analyzed to fully understand the problem and find an attainable solution.

Musculoskeletal Crisis

According to the Bone and Joint Decade report (2008), “more than one in four Americans have a musculoskeletal condition requiring medical attention. The direct and indirect costs for bone and joint health are 849 billion or 7.7% of the gross domestic product” (2008, p. ix). This is a health crisis future generations should avoid. Based on current research the magnitude of the problem is alarming. Few are aware that President G. W. Bush declared 2002 to 2011 the U. S. Bone and Joint Decade. An international collaborative movement has been sanctioned by the United Nations World Health Organization to improve the quality of life for people with musculoskeletal conditions, while advancing the understanding, prevention, and treatment of these conditions (2008). Many studies from around the world are finding that misalignment, fatigue, and other health-related concerns are a worldwide problem (Deyo et al., 2010; Grattan-Smith, Ryan, & Procopis, 2000; Hollingworth, 1996; Mikkelsen et al., 2008; Widhe, 2001).

The majority of articles were written in the past 10 years. Researchers are starting to quantify the postural problems of school-age children; hence there is limited literature on school-age population. In 2009 only three studies were found. Currently, fewer than 30 research articles offering school-based solutions have been located. A majority of the articles were written in Europe and often needed translation to English. The United States is just beginning to address the problem of children's postural problems. Research in this area is necessary to alleviate the current demand for health care related to childhood back pain.

A cohesive body of research is beginning to emerge. A review of the literature indicated five main themes: 1) the current state of children's posture; 2) the negative effects of postural misalignment; 3) the possible causes of misalignment; 4) what interventions have been explored; and 5) how posture affects learning engagement. Children's posture is a worldwide concern, as studies were reported about children in Belgium (G. M. Cardon et al., 2007; Dolphens et al., 2011), South Africa (Brink et al., 2009), Israel (Dekel & Heyman, 2008), the United States (Gillespie, 2002), Denmark (Harreby et al., 1999), France (Perez-Christiaens, 1982b) and England (Murphy, Buckle, & Stubbs, 2004) to name a few of the countries. Observations of children in Alaska show this similar alarming trend of limited core strength and poor postural alignment (T. Roon & T. Sabbens, personal communication, October 29, 2012).

Current State of Children's Posture

Gravity and the structure of the spine play an important part in our ability to stand upright (Vernikos, 2011). Children's posture alignment has to be perfectly aligned in order for them to make those first few steps. Children quickly tumble when their core strength cannot maintain the alignment. As they learn to walk, children develop that core strength to maintain their alignment. Without perfect alignment, gravity causes toddlers, in the beginning stages of walking, to find themselves on the ground time and time again. Unfortunately, once they have conquered bipedalism, they consciously want to mimic the appearance of their parents, siblings, and peers (Lakin, Chartrand, & Arkin, 2008); hence the poor posture and onset of eventual pain. One finding reported that one out of five school-age children report low back pain (LBP), the main cause being mechanical (spinal misalignment) or lack of strenuous physical activity (Boćkowski et al., 2007). Children need to have more time for play and gross motor activities. Vernikos (2011) reports that just standing up multiple times a day can have a positive effect as it stimulates every nerve, causes muscles to contract and initiates a shift in bodily fluids, volume, and hormones – it engages gravity.

Children's ability to maintain a spinal alignment is rapidly disappearing along with their ability to attend to task (G. Cardon & Balagué, 2004; Murphy, Buckle, & Stubbs, 2007). The crisis of childhood obesity the United States faces is due to lifestyle changes. The increase in obesity parallels the increase in advertising and inexpensive fast foods and high-fructose syrup used in soft drinks and snacks (Canoy & Buchan, 2007; Pohl, Stephen, & Wilson, 2006). Teaching children about nutrition could have positive effects. This more sedentary generation relies on low-nutritive, high-fat, and high-sugar

foods; views an average of 7.5 hours daily of entertainment media; consumes larger food portions; and has reduced and/or no school activities such as physical education, recess, and extra-curricular sports. One in three children nationwide are classified by the Centers for Disease Control and Prevention as being obese, nearly triple the number of the 1970s (Obama, 2010). As the United States and Alaska come to terms with childhood obesity public service announcements that encourage children to be more active are being aired on both national and state television and radio. Active children have more energy to continue to improve their postural strength. Pressure to increase test scores by decreasing free time and recess is unfortunately a counterintuitive approach.

The Effects of Postural Misalignment

Many of the studies on children and adolescent posture use highly technical measuring devices to quantify the existence of postural misalignment. The Biotonix system uses reflective markers attached to the body prior to creating photographs of the subject, which can be analyzed with software (Lafond et al., 2007). Others use similar systems, although the reflective markers are extended from the body several inches (Brink et al., 2009). In both of these studies, participants are minimally dressed in a leotard or swimsuit (females) or shorts and shirtless (boys) to see the angle of the bones in photographs. Replication of a similar study would not be possible in the American school system due to our anti child pornography laws.

Researchers worldwide are concerned about children's postural health. As shown by a growing concern in the literature, researchers are searching for a solution to the

growing disfigurement, discomfort, and pain experienced by children. In their cross-sectional study of 1084 children aged 4–12 years, Lafond et al. (2007) quantified the existence of a sagittal plane misalignment that increased with age. They measured this change in alignment with a machine called the Biotonix postural analysis system, which measures the key joint angles and the alignment of the head, shoulders, thorax, pelvis, and knee (plumb line) (Lafond et al., 2007). They further determined that once a certain level of tolerable postural displacement is reached, back and neck pain may be the result. In reality there should be interventions to avoid this postural displacement, to find either pain-free student seating or provide more classroom movement to increase student core strength and postural alignment.

Other studies determined anthropomorphic measures, such as height, weight, muscle tone, and strength in a hospital or doctor's office where they used nutrition led measurement devices (E. Geldhof, G. Cardon, et al., 2007; Maloiy et al., 1986). Medical studies used radiology, X-rays, and MRI (Buderath et al., 2009; Keller, Colloca, Harrison, Harrison, & Janik, 2005). Many studies used center-of-gravity or center-of-pressure machines, which measured postural sway (Melzer, Benjuya, & Kaplanski, 2001; Olivier, Palluel, & Nougier, 2008; Weeks, Forget, Mouchnino, Gravel, & Bourbonnais, 2003). Others used optical flow patterns of approaching or receding circles of light to determine postural stability (Baumberger, Isableu, & Flückiger, 2004). The multiple rigorous measuring conditions all have quantified that children have postural misalignment. Unfortunately, these approaches would disrupt the educational process and are not practical in schools in the United States.

The most noted effect of postural misalignment besides misshapen form is pain. Several studies focused on survey results reporting low back pain (LBP). Some hypothesized the main cause of LBP is the decrease of activity and the increase of sitting in static positions. For example, an Australian review of studies examining a sedentary lifestyle and LBP confirms that sedentary lifestyle by itself is not associated with LBP (Chen, Liu, Cook, Bass, & Lo, 2009). However, the way children are now sitting on their lumbar spine versus their ischium could be a factor. In Poland, another study of school-age children concurs that the cause of LBP is mechanical (poor posture) and associated with the lack of strenuous physical activity and exercise (Boćkowski et al., 2007), not posture alone. The musculoskeletal system needs impact and engagement to stay healthy. The current “Stay Healthy Play 60” campaign to get children up and moving encourages this type of activity and is filtering down to state campaigns (NFL, 2011). Alaskan Olympic athletes are visiting schools to encourage more physical activity daily; students are excited to get out of their seats and do something fun (Alaska, 2010; Shah, 2011).

Other studies looked at the upper vertebrae or the cervical and thoracic area of the spine. When students lean back in their chairs they must extend their head and neck toward the desk causing spinal misalignment (C. Krebs, personal communication, October 24, 2011). In a study of South African high school students, researchers found that upper quadrant musculoskeletal pain may be caused by posture (severe cervical and thoracic angles) when using computers (Brink et al., 2009). They discovered that students who are not using ergonomically correct seating often get into a variety of contortionist’s positions in search of comfort. Students will lean into the computer screen with a

gooseneck and often a bend in the upper thoracic spine. In a study of 1446 children age 11–14 in England, 24% of the children reported back pain, yet few of the respondents sought medical attention (K. D. Watson et al., 2002). There seems to be a disconnection between the mind and body; unaware of the underlying damage, respondents would rather ignore pain than get to the root of the problem to fix it (J. Couch, personal communication, July 18, 2011).

Postural misalignment continues to be a factor in reports of pain by children and adolescents (E. Geldhof, D. De Clercq, et al., 2007; Kovacs et al., 2003; Kratenova et al., 2007). The Burden of Musculoskeletal Diseases in the United States report predicts a severe shortage of orthopedic surgeons in the next 30 years (American Academy of Orthopaedic Surgeons, 2008). If we can find an effective intervention perhaps we can avoid this surgical crisis. Unfortunately, surgically altering or replacing bone requires an extended healing time, which can cause a further weakening of the musculoskeletal system (American Academy of Orthopaedic Surgeons, 2008).

Causes of Misalignment

Research shows many compounding factors contributing to the loss of spinal strength across home and school settings (Yosifon & Stearns, 1998). Our lifestyle is much more sedentary than in the past, most of the population does not participate in hard physical labor, and people are rushed and on the go, often grabbing a prepackaged meal or fast food to replace high-quality home-cooked meals containing fresh ingredients (ABC News, 2011). All these factors contribute to GDS (Vernikos, 2011). Convenient,

low-quality, high-fat foods consumed habitually leads to obesity and secondary diseases such as type 2 diabetes, cancers, liver disease, and conditions of high cholesterol, and recurrent abdominal pain (Malaty et al., 2007; Spruijt-Metz, 2011). Obesity contributes to a more sedentary lifestyle and reduction in physical activity (Katzmarzyk et al., 2008; Lytle, 2009). Reduction of physical activity is a leading cause to a decline in bone health which will then affect posture (Briggs, Straker, & Wark, 2009). Many schools in Fairbanks have community gardens where students learn gardening techniques to produce high-quality fresh foods. This not only increases students' physical activity, but it also provides a source of high-quality foods. Students enjoy eating what they have grown and find exciting new recipes to prepare nutritious meals.

Billions of dollars every year are spent on advertising to influence behavior. About \$1.6 billion covers advertising directed to children under 18 who are consuming empty calories, causing an increase in obesity, and a decrease in core strength resulting in poor posture (Stovitz, Pardee, Vazquez, Duval, & Schwimmer, 2008; White House Task Force on Childhood Obesity, 2010). Children who have poor bone density are at risk for having fragile bones sooner rather than later in life; physical activity and good nutrition are two solutions to this problem (Briggs et al., 2009). One positive aspect of No Child Left Behind is eliminating high-calorie snacks and drinks and limiting what is offered in schools' vending machines. New trends in public service announcements encourage children to be active and play at least 60 minutes each day. Recently, Michelle Obama encouraged teachers to design lessons that involve movement (Obama, 2013). Saying the ABCs while doing jumping jacks or following the path of oxygen in a human lung-and-

heart obstacle course mapped out in the gymnasium are two possible active learning lessons. Creative teachers can find unlimited activities to keep students up and moving while learning.

The digital society also spends more sedentary time connected to technology (e.g. smart phones, MP3 players, computers, television, iPods, iPads) for work, school, and entertainment (Liou, Liou, & Chang, 2010; Pan, Lee, Chuang, Lin, & Fu, 2008). Individuals using this technology are often slumped in poorly designed furniture and do not develop the core muscles that support spinal alignment (Dockrell, Fallon, Kelly, Masterson, & Shields, 2003; Straker, Maslen, et al., 2009). This has had a profound effect on body posture. Students are, in fact, expected to spend many hours a day using electronic devices to accomplish school assignments (Bennett & Tien, 2003; Gillespie, 2002; Lui, Szeto, & Jones, 2011; C. D. Williams & Jacobs, 2002). Place-based education that allows students to get out in the community is one way to unplug, move, maintain good musculoskeletal health, and develop observational skills.

Western and other developed societies have opted for comfort over strength and stability. Many deep-cushioned furniture designs offer no support and often do not allow users' feet to touch the floor. Many designs feature a bed-like structure to be placed in front of a screen, discouraging movement. In schools, the standard molded plastic chair is often the only option. The ergonomic needs of individual students are rarely considered when students are assigned to a chair and desk. Human beings were designed to move and stay active (Heuer & Sülzenbrück, 2012); this sedentary lifestyle emulated in various media only increases the demand on the medical industry as inactive people put

themselves at risk for health problems (L. M. Bell et al., 2011; Gilleard & Smith, 2007; Katzmarzyk et al., 2008; Stovitz et al., 2008).

Another risk factor is the excessively heavy backpacks carried to school every day. Children's bones grow rapidly and are less able to withstand stresses on the spine than adults' (Feingold & Jacobs, 2002). Putting excess weight on growing bones contributes to back pain (Brackley et al., 2009). Many children do not learn how to properly load and wear their backpack. Adolescents report more instances of back pain attributed to heavy backpacks due to the increase in textbook weight and material carried (Chow, Ou, Wang, & Lai, 2010; Dekel & Heyman, 2008; Feingold & Jacobs, 2002). Excess weight on the growing spine contributes to various postural misalignment, including kyphosis, shoulder and back spasms, sprains, strains, and fractures (Moore, White, & Moore, 2007; National Safety Council, 2009). The emergence of mobile devices as reading tools has schools shifting away from textbooks to e-reading devices (Resnick, 2011). One mobile e-reader device is significantly lighter than one or more textbooks.

Incidence of musculoskeletal impairments is both self-identified and reported to health providers at such a high rate that it is one of the most common medical disorders (Cunningham & Kelsey, 1984). These impairments can cause reduced mobility and strength, as well as altered posture (Gilleard & Smith, 2007). The 2008 Pixar Animation Studios movie *WALL-E* illustrates the future of humankind's weakened posture (Stanton, 2008). In this movie, humans are no longer capable of bipedalism; their corpulent bodies are carried around on reinforced couches. This image is not far from modern-day truth in

the West; there are far too many obese people (Canoy & Buchan, 2007). Instead of increasing physical activity and nutritious meals, the more expensive procedure of bariatric surgery or laparoscopic adjustable gastric banding is being performed on adults and children (Diconsiglio, 2006; Kelleher, Merrill, Cottrell, Nadler, & Burd, 2013; Pohl et al., 2006). Social and digital storytelling depicts a human's decline as he hunches over his computer station (McAllister, 2009) and may create awareness in the culture of humankind's increasing deformity of spinal misalignment.

Spinal alignment problems in children are interrelated on many levels. Research shows several closely tied issues: specifically an increase in sedentary lifestyle arising out of an increase of technological games, educational requirements, and work-related tasks. Children spending more sedentary time at school and at home suffer the unnatural results of decreased muscle tone, increased obesity, and secondary diseases that include musculoskeletal disease (Liou et al., 2010). Once embroiled in this cycle, it becomes harder for children to become active due to increased weight and loss of musculoskeletal strength. In short, it becomes more difficult and less enjoyable to be physically active (Gierlach, 2002; Harreby et al., 1999). By increasing activity throughout the school day students can get over the initial distaste for movement and may be more likely to be active at home too.

Some of the common injuries due to these changes in lifestyle and use of technology include low back pain, carpal tunnel syndrome, computer eye syndrome, wearing out of the muscle lining of the thumbs due to texting, neck and back pain, repetitive stress injuries, and poor circulation throughout the entire body due to extended

sitting (Chen et al., 2009). The cost of on-the-job injury for adults arising out of computing technology is being researched by the U.S. Department of Labor's Office of Safety and Health Administration and is estimated at around \$7,000 in health and business costs per injury (USDOL, 2011).

Due to the high cost to businesses from workstation and computing injuries, a new field, ergonomics, emerged. Ergonomics is the study and design of equipment and devices to fit the human body and its movements. Curiously, there is no consensus about standard measurements among ergonomists. Currently there are three schools of thought for posture in the field: a 90° knee angle, 90° torso-to-hip angle, and a 90° elbow angle position (the elbow angle is often drawn at 110°); a tilted-back lumbar supported position; and a forward slant that allows a more open 135° torso-to-thigh angle on a taller seat (C. Krebs, personal communication, October 24, 2011). Some organizations will not assign an employee a desk without first conducting an ergonomic evaluation. Even with these philosophical differences, evaluations are saving companies money in health-care costs and reduced employee sick leave (USDOL, 2011).

Unfortunately, these ergonomic principles are not being considered in our children's schools (Brewer, Davis, Dunning, & Succop, 2009; Straker et al., 2002; Straker, Skoss, Burnett, & Burgess-Limerick, 2009; Troussier et al., 1999). One of the leading predictors to back pain in adults is prior back pain (G. Cardon, De Bourdeaudhuij, & De Clercq, 2002). Students could maintain good back health if schools incorporated ergonomic concepts.

School districts order furniture based on manufacturer's recommendations of grade-level body size and type. Given the size variations of students in any given classroom, this style of ordering will be wrong for many of the students. Students are often in chairs and desks that are too large; hence, students are unable to have their feet firmly on the floor to stabilize a comfortable posture. Anthropometric data, such as student height, leg and torso length and weight are essential for this design (Chung & Wong, 2007; Gracia-Acosta, 2007; Jeong & Park, 1990; Mokdad & Al-Ansari, 2009; Molenbroek, Kroon-Ramaekers, & Snijders, 2003). Worldwide, researchers agree it is important to put students in furniture that matches their size and that changes as they grow. When students sit in a chair, their feet need to be flat on the floor and the table or desk they use should be at a comfortable height for them to rest their arms for writing. A study in France determined that children did indeed prefer ergonomically designed school furniture (Troussier et al., 1999).

One final factor is the power of social marketing; the influence of society and social media on children cannot be denied. Our children are easily influenced by marketing and tend to emulate models whose bodies are often contorted and misaligned (Derenne & Beresin, 2006). The evolution in the 1920s from a strong posture to that of the more trendy, therefore, attractive, slim, jazz/swing dancers commonly known as flappers was caused by the social marketing of the day (J. Couch, personal communication, January 15, 2009). "Comfort" was the ideal that was selling, from more relaxing furniture to looser-fitting clothes. The "glamour" poses of the times illustrated women jutting their hips forward and throwing their heads back, carefree and relaxed

(Fangman, 2004; Scheurer, 1990). Women emulated those poses and their children copied them (Yosifon & Stearns, 1998). What was once considered proper posture no longer served as a social marker by the 1960s, even though many prestigious schools held classes in proper posture, made anthropomorphic measurements of the students, and kept records (Yosifon & Stearns, 1998). Television, billboards, magazines, and newspapers portrayed a more relaxed open posture that included slouching and slumping. Students who study posture with Couch and Hackney at the Balance Center, recognize these images as weak, misaligned structures (K. Hackney, personal communication, June 3, 2010). Balance students are given a variety of contrasting photographs as an exercise to distinguish both postural alignment and misalignment. The premise for this exercise, is that if you can distinguish, then you can self-correct your own posture (J. Couch, personal communication, January 15, 2009). An instant short-lived correction is usually the only result; maintenance of spinal alignment without the core strength is nearly impossible.

As humans we naturally want to be part of a group to benefit our survival, adjusting mannerisms, including posture is associated with fitting into a group at a subconscious level (Kawakami et al., 2012). When we mimic others, we are more accepted (Lakin et al., 2008), and therefore bad posture is not easily remedied. Our postural model to mimic must change back to one of spinal alignment, strength, confidence, and assurance (Briñol, Petty, & Wagner, 2009).

Back Education Interventions Explored

Researchers only recently determined there is a problem with children's posture worldwide (Phélip, 1999). This appears to be a relatively new area of concern, since most of the articles found were within the past 10 years, with many of those within the past five years. Although there are many intervention ideas for adults, when I became interested in this research, only two elementary school based postural education programs were located to date (Dekel & Heyman, 2008; E. Geldhof, G. Cardon, et al., 2007). The lack of these programs, in light of the literature found on musculoskeletal discomfort or pain in children and adolescents, is startling but understandable since this is a new area of research. Indeed, studies may be underway now that will be reported in the next few years.

The first two school-based interventions that address postural alignment are more of a best-practices type than research based studies. One is an educational program called Ergonomics, Movement and Posture (EMP), which was taught in elementary schools by a Physical Education student teacher of the Kibbutzim College of Education in Tel Aviv (Dekel & Heyman, 2008). In the EMP program, children learned about the human body, including the structure and function of the bones, joints, muscles, and spine. Other concepts taught were how to locate the center of gravity; how the body works as a lever system; movement, balanced posture and body awareness; sitting; and lifting, pushing and carrying (school bags) (Dekel & Heyman, 2008). Dana Rozan, a former student of Heyman and Dekel's used life-size models of the human spine to point out its functions. Students practiced postural alignment and misalignment to feel the contrast between the

two. They used hula hoops to teach body awareness, balance and movement. Students enjoyed the activities and practiced them throughout the week.

The second elementary postural education program took place in Belgium. It was a two-year study demonstrating an intensive postural education program at the elementary school level with 8- to 11-year-olds (E. Geldhof, G. Cardon, et al., 2007) This study looked at three aspects of back function: trunk-muscle endurance, strength capacity of the leg muscles, and spinal curvature. They also used a parental and child questionnaire to determine children's level of physical activity outside of school. Intervention in the school included six back education lessons given weekly by a physical therapist. Topics included the anatomy and pathology of the back regarding lifting and carrying loads; the biomechanical principles of sitting, standing, lying, bending, lifting, and pushing; and finally, practice sessions for each position (E. Geldhof, Cardon, De Bourdeaudhuij, & De Clercq, 2006, p. 1966).

Material was also given to the teacher to integrate the back posture principles into classroom activities. Short movement breaks were given between lessons. Participants had wedges and exercise balls to sit on in the classroom to assist dynamic sitting posture. Researchers had the children and parents come in to a medical setting for pre- and post-testing and to record the anthropometrical data of each child. Under these controlled conditions, they determined that there was an increase in endurance of trunk flexor muscles in the intervention group and a decline of trunk flexor endurance of the control group. This alone was significant enough to promote good body mechanics education throughout the elementary curriculum in Belgium. No significant difference in the other

back function aspects of leg endurance or spinal curvature between girls and boys in the study was found. In a two-year follow-up study, 96% of the children (now age 10–13 years) who received the intervention still remembered the back education. Fifty-five percent almost always or always and 35% sometimes continued to use the learned biomechanical principles (E. Geldhof, Cardon, De Bourdeaudhuij, & De Clercq, 2006). This is an encouraging finding that this type of early back education intervention can have lasting effects.

In the findings of Cardon’s eight-year follow-up study the discussion states, “The current study results thus suggest spinal care behavior in adulthood not to be affected by predominantly biomechanical-oriented back education programmes implemented during childhood” (Dolphens et al., 2011). This long-term study found only 6.2% of the participants sporadically used the back education information they learned. This significant decline could be due to the lack of an ongoing back education program taught throughout the school years. Cardon reports, “I’m now mainly working on promotion of physical activity and less sitting, I’m not really working on posture” (G. Cardon, personal communication, August 9, 2011). His change to increasing physical activity may solve the sitting problem. Students who have stronger core muscles will naturally sit in postural alignment and avoid GDS (Vernikos, 2011).

Other researchers explored the question of whether allowing teachers to allow for movement throughout the day would reduce student risk factors for back pain (Boćkowski et al., 2007; Breithecker, 2011; G. Cardon et al., 2004). Students are beginning to notice their own poor posture. For example, a group of four middle school

students, known as the “Back Straight Boys” won the 2009 Christopher Columbus \$25,000 award competition for their posture pad invention, a computer program designed to help the occupant of a chair improve his or her posture (Loye, Epstein, Walsh, & Colford, 2011). Student creativity paired with desire to improve posture is a welcome sign.

In an ergonomic educational intervention targeted for middle school children and home computer use, researchers taught ergonomic principles to students (C. D. Williams & Jacobs, 2002). The increased knowledge of ergonomics translated to the home, and when the students used their home computers, they sat in postural alignment. The computer workstations did not change as researchers hypothesized, even though parents and children increased and retained their knowledge of ergonomically sound principles (C. D. Williams & Jacobs, 2002). Knowledge of postural alignment must be matched with both practice and implementation of postural alignment and social models of postural alignment for it to be an effective intervention. The authors’ purpose that having only one area in which posture was important was not enough. One question to consider from this study is, “If the researcher had showed them how to make all of the seating in their house ergonomically correct, would the effects have been more noticeable?” (C. D. Williams & Jacobs, 2002). Does the improved ergonomic arrangement improve posture, or does the increased sitting cause a decline in muscle tone regardless of the ergonomic arrangement?

Adaptive yoga has, within the last few years, gained acceptance in the educational community for students with various abilities and disabilities (Behar, 2006; Churnin,

2010; Orr, 2009; Peck, Kehle, Bray, & Theodore, 2005; Schwartz, 2006). Sanford's work ties my interest in postural alignment to a professional interest in special education. I have attended both of Sanford's adaptive yoga workshops Level I and II, which provided valuable instruction in two key areas: teaching the experience of a pose when the student physically may not be able to attain it, and observing and participating in an adaptive class. People from across the United States and Canada participated. Sanford and his instructors helped the participants (non-disabled) internally experience the poses so they could figure out how to teach and support these poses for students with varying health issues and who might not be able to feel below the neck (M. Sanford, personal communication, April 23–25, 2010). I have never been more inspired by people who knew improved muscle tone would actually allow them more comfort in their wheelchairs. Adaptive yoga inspired a more positive outlook on life and increased their ability to do their daily activities with ease. Paraplegics and quadriplegics are actually reversing the trends of GDS, improving their breathing, and increasing their voice and their stability in their wheelchair, through what limited movement they can make with the help of the yoga instructors (M. Sanford, personal communication, April 23–25, 2010).

One long-running program, the President's Council on Physical Fitness, which was established in 1956, encourages physical fitness throughout the United States (United States Government, 2011). President Obama and Michelle Obama are working together to solve this problem within one generation. Michelle Obama's Let's Move campaign is gaining in popularity and has collaboration with the following departments: Health and Human Services, Agriculture, Education, and Interior; in addition, the NFL's Fuel Up to

Play 60 is intended to create a swift and significant change in children's lives (Obama, 2010). Fuel Up to Play 60 encourages healthy eating by following the USDA guidelines and playing a minimum of 60 minutes per day to maintain a healthy body (NFL, 2011). Fuel Up to Play 60 teamed up with Michelle Obama's national program, "Let's Move, America's Move to Raise a Healthier Generation of Kids" (Obama, 2010). Promoting healthy behavior can be quite powerful when policy makers work with health educators in the schools (Arms et al., 1997; Lippke & Ziegelman, 2008). Teachers and students alike would benefit from a more active educational program teaching concepts through movement.

Connecting the various public health organizations together via the Web and to schools and educators would make implementation of health initiatives much easier. One example is the Best Bones Forever site (a girls' bone health site operated by the federal government), which does not mention posture at all, and the Straighten Up America site (posture and healthy bones focus), which offers links only to a chiropractic college (Girlshealth.gov, 2011; Kirk, 2006). Neither of these sites link to Let's Move or Fuel up to Play 60: having all these sites link together would be beneficial. A clear message portrayed by people who model spinal alignment will help with the marketing of a healthy spine. These messages also have to address ergonomic furniture issues. Further collaboration of these entities would improve student access to healthful information.

The HEALTHY study intervention, which targeted healthy eating to reduce obesity, expanded its social marketing to include social media such as verbal messaging, student-led events, student-generated media, and distributions of theme enhancers outside

of the target area (DeBar et al., 2009). Personalized online strategies combined with mass media increases the effect of any campaign to improve health (Cugelman, Thelwall, & Dawes, 2011). However, to create a behavior change one must use a principled multidisciplinary approach that includes modeling, engaged teachers and researchers with aligned spines, not marketing, campaigns, and persuasion alone (Robinson, 2011). Public health organizations can learn from corporate marketing leaders, but they must outlast and out-brand them to influence the public's behavior (Stead, Hastings, & McDermott, 2007). These health education programs must be applied to the consumer in the classroom and be recognized in the general public as the preferred status quo for significant change to occur (Stellefson & Eddy, 2008). Corporate interests are currently stronger than the health advocates.

A more commercialized approach to the obesity problem is the ABC show *Jamie Oliver's Food Revolution* (ABC News, 2011). This show points out how easy it is to make a change to a more nutritional intake in our schools. Oliver actually works with school districts to help implement the changes. Nutrition and movement are key to spinal health. Nutrition and health are clearly inseparable.

Unfortunately, to date only 16 researchers have published articles highlighting postural education interventions with children. In Europe, when children are evaluated for back strength and form, they are referred, if needed, to a physical therapist or required to enroll in an exercise regime to improve their back strength (Orr, 2009; Schmid, Van Puymbroeck, & Kocejka, 2010; K. Williams, Steinberg, & Petronis, 2003). The opposite is

true in America, where people tend to see a physical therapist after they have had surgery to correct the problem not before.

When people stop using the musculoskeletal system naturally, they are prone to more health-related problems as they age (Chen et al., 2009; Kriemler et al., 2010) and speed up the aging process (Vernikos, 2011). When the elderly in the West fall down, they often break their fragile bones and require long-term care (Liu-Ambrose, Khan, Eng, Lord, & McKay, 2004; Marigold et al., 2005; Ullmann, Williams, Hussey, Durstine, & McClenaghan, 2010). Broken bones for the elderly often bring high medical expenses and mark the beginning of the loss of independence (Ullmann et al., 2010). My intent is to develop strategies for children so they will avoid these serious postural problems in the future.

Parents can encourage a variety of physical activities after school and at home. However, many parents who work rely on screen-time activities for their children. When children are captivated by games and shows displayed on technological devices, quietly sitting, it gives parents a break from their own hectic schedule. As previously stated, the increase in sedentary lifestyle choice ties into poor overall fitness (I. M. Williams, 2002). The classroom may well be the place to turn that around by providing more active learning and improving student overall muscle tone. Then children would prefer staying active at home too.

The many problems associated with misalignment of the spine must be met with multidimensional educational solutions. Solutions need to incorporate strengthening of the musculoskeletal system, an awareness of postural misalignment problems including

visual identification, and increasing student movement during the school day to activate the natural mechanisms of spinal health (Vernikos, 2011); ergonomic workstations that allow proper positioning of children at their desks and computer stations (Dekel & Heyman, 2008; C. D. Williams & Jacobs, 2002); education on backpack safety; and a social marketing program that makes postural alignment an important goal. Current health-promoting programs in the United States such as the Best Bones Forever website sponsored by Girls Health has no mention of posture alignment (Girlshealth.gov, 2011). The little-known Straighten Up America Campaign introduced in 2006 to 29 fourth- and fifth-graders is an open access program; however, the developer has no way to determine the extent of its use or get feedback on its effectiveness (Kirk, 2006). Random unlinked websites will not be the answer to the problem as they are not part of a nationwide or worldwide push for improvement.

Misalignment in the School Environment

Possible causes of misalignment in the school environment include the following: non-ergonomically designed furniture, increased use of technology, and heavy, improperly used backpacks and bags. Jacobs and Baker (2002) determined that computer use was causing musculoskeletal discomfort in children similar to the level reported in adult literature. They also felt that children, who spend more and more time using computers, would be protected if they had ergonomically correct workstations that met their size needs (Jacobs & Baker, 2002). Achieving awareness of ergonomic principles in

the schools will take prioritizing it along with postural education in teacher-education programs.

Poorly designed furniture and the students' static sitting position for the majority of the school day contribute to misaligned posture (Vernikos, 2011). In France, researchers found forward inclination increased with age when looking at the effects of optical flow patterns on posture in children and adults (Baumberger et al., 2004). In a recent study in Australia, researchers encouraged task variety to decrease muscle monotony caused by increased computer/IT usage in schools, which leads to musculoskeletal discomfort (Straker, Maslen, et al., 2009). A study in Belgium, found similar sedentary trends: "pupils sat statically for 85% of the time, 28% of which the trunk was bent or flexed forward" out of alignment (E. Geldhof, D. De Clercq, et al., 2007, p. 1521). Occupational therapist presenting on sensory needs, shared that school-age children need a movement break every 15 minutes to be at peak condition to learn, while adults (teachers) need a break at least every 50 minutes to maintain engagement to task (G. Wild, personal communication, October 25, 2011). The average lesson/class length, however, in elementary school is 30 minutes, in middle or junior high 50 minutes, and in high school 60-80 minutes—over twice, three times and five times as long a wait to move for students.

Humans need to use muscles and bear weight on their bones to maintain healthy musculoskeletal systems but studies are showing a decline in healthy use (Straker & Mathiassen, 2009; Vernikos, 2011). Children and adults are doing fewer activities that keep their bones healthy, with a devastating result—the loss of postural alignment and the

strength it produces. Perhaps the most startling findings were those of premature aging in adolescence. A European MRI study shows unhealthy spinal columns which are already breaking down like those of a much older person (Phélip, 1999). Adolescents experiencing disc problems that need medical attention is indeed a health crisis (H. Gappert-Hocchalder, personal communication, August 17, 2011). Sedentary activities, that children are choosing, compound their misalignment. Children's posture is a worldwide concern as more and more researchers quantify a shift in the spine through MRIs, photographic measurements, and changes in weight when shifting to balance. Researchers are looking at children's posture from many directions, and they are confirming each other's findings that there is indeed a dramatic shift of postural alignment (Brink et al., 2009; Dockrell et al., 2003; Kristjansdottir & Rhee, 2002; Murphy et al., 2007). Unfortunately, poor health must reach crisis stage before people notice and want to make a change that will abate the problem.

One final contributing factor school-age children face when going to and from school and classes is a heavy backpack. A U.S. researcher explains that children carrying overstuffed backpacks weighing upward of 15% of their body weight may be the cause musculoskeletal discomfort or pain (Gart, 2004). He offers six tips on how to safely wear backpacks:

- Load no more than 15% of your body weight
- Limit use of backpacks
- Use both straps adjusted to fit
- Recognize when it is too heavy
- Select a good backpack that allows you to equally distribute the weight

- Lift the backpack correctly (Gart, 2004).

Overloaded backpacks not only exacerbate the health risks in the child wearing it, but they also can cause harm in a crowded hallway when the student turns suddenly. Using lockers and limiting loads in a correctly worn backpack will keep children from harm.

How Posture Affects Learning Engagement and Attention

In a study of fourth-grade children in Maryland, researchers determined when children had chairs and desks that fit their height and size students attended to task more and sat better (Wingrat & Exner, 2005). Although this is logical, teachers are rarely given the luxury of choosing furniture that meets the needs of their students. It is not uncommon to walk into any classroom and find children unable to reach the floor with their feet because a chair is too big or that they have their knees higher than their thighs because of a small chair. Some chairs and desks are adjustable but most are in a static, unmovable position.

One study in India found that classroom furniture should be redesigned to reduce health complaints (Dhara et al., 2009). When sitting in uncomfortable chairs, students tend to lie over their desks, use their hands to hold up their heads, and slump down in their seats. In this position, students end up sitting on their lumbar vertebrae instead of their ischium. To maintain mental clarity students move by tipping back in their chairs, often rendering the chairs broken and unusable. Students who are in pain, uncomfortable, or on the verge of falling asleep are not able to concentrate, nor will they do their best on

the task at hand. With this in mind, how can they possibly pay attention or be engaged in their learning?

Different ergonomic philosophies are often born out of casually related activities. Parents of children with disabilities often seek out therapeutic horseback riding programs to help increase their children's balance and core strength. They are often amazed by their child's ability to sit while on horseback as compared to their inability to stay seated in a regular school chair (K. Brown, personal communication, March 15, 1998). Inspired by therapeutic riding programs for children who are disabled, Mary Gale, an occupational therapist from Australia, designed a saddle seat chair (Gale, 1997). This chair incorporates non-standard ergonomic principles: allowing the leg to be more extended, the ischium to rest on the chair and the spine to balance effortlessly. Breithecker, another furniture designer stresses allowing children to move within their seats and throughout the classroom to encourage postural health (Breithecker, 2008). Being able to move freely is also associated with having book bags that do not weigh students down.

A German study found minor cerebellar (brain) dysfunction of children with attention deficit hyperactive disorder (ADHD), which may contribute to their postural deficits (Buderath et al., 2009). Brain imaging showed that children with ADHD had cerebellar lesions affecting the areas of gait and balance. They typically have a hard time maintaining a static position and are in constant motion in search of vestibular and proprioceptive input (Buderath et al., 2009; Olivier et al., 2008; Weeks et al., 2003). Providing additional movement and practice within the smaller confines of a classroom could help the child develop new neural pathways and better coordination.

Summary and Conclusion

The decline of postural alignment in children is a current topic of concern as the incidence of back pain in school-age children has been well documented. In order to make a significant change in the way people behave, social marketing programs combined with health education have proven effective (Weger, 2011). Facilitating a change to children's postural misalignment will take more than educational awareness, models, and reminders. Making students, parents, and teachers visually aware of good posture alignment is an initial step. However, a multidimensional approach is needed to implement change towards postural alignment and improved engagement in learning.

Children's posture is in a very unhealthy state. Inability to stand in balance with gravity is demonstrated when there is no longer equal distribution of weight along a plumb line, and students look uncomfortable. Now there are documented studies which measure the angle of the misalignment (Brink et al., 2009; Lafond et al., 2007) and degeneration of the spinal discs (Phélip, 1999). Children are spending more time not moving whether it be during the school day, using IT devices, or at home watching TV; they are not getting the strenuous exercise their bones and muscles need to remain healthy (Straker, Maslen, et al., 2009; Straker & Mathiassen, 2009). Bone remodeling occurs with impact like jumping rope or playing basketball or hopscotch. The work of the child is to play; parents and educators can help by encouraging activities that promote musculoskeletal health.

The majority of the studies examined were concerned with the effects of postural misalignment. In a large study in England, 24% of the respondents (aged 11–14) reported

musculoskeletal pain (J. C. Watson, Payne, Chamberlain, Jones, & Sellers, 2008). A South African study reported upper quadrant musculoskeletal pain (Brink et al., 2009), while another study reported lower back pain among the participants (Boćkowski et al., 2007). All the studies stress urgency in their discussions and conclude that this problem needs to be addressed immediately or children may be disabled as adults.

The possible causes of misalignment varied from mechanical (poor posture) (Jacobs & Baker, 2002), sedentary life style (Jacobs & Baker, 2002), lack of strenuous exercise (Straker & Mathiassen, 2009), poorly designed furniture (Chung & Wong, 2007; Gracia-Acosta, 2007; Jeong & Park, 1990; Mokdad & Al-Ansari, 2009; Molenbroek et al., 2003), to overloaded school bags (Gart, 2004). All of these factors contribute to musculoskeletal discomfort or pain in schoolchildren.

The most interesting part of this literature review was that only a few postural education interventions have been explored. In one elementary research study in Belgium that tracked students for two and eight years in a postural education program, initial positive results all but disappeared after eight years in the longitudinal follow-up study (Dolphens et al., 2011; E. Geldhof, Cardon, De Bourdeaudhuij, & De Clercq, 2007). This change over time could be attributed to the lack of ongoing postural education (Dolphens et al., 2011). Another elementary program was reported to be effective, but was not research based (Dekel & Heyman, 2008). The only other study was a home-based intervention for middle school students. Parents and children effectively learned about ergonomics, but did not put their new knowledge into practice (C. D. Williams & Jacobs, 2002). The problem of postural misalignment is well documented. The fact that

there is only one effective research-based intervention study certainly leaves the prospects of additional studies wide open. The ergonomic studies do offer a partial solution: students sitting in furniture that actually fits their size is certainly a step in the right direction. However, when one considers the forty years of ethnographic study of postural alignment done by Perez-Christiaens (1982b), many of those participants maintain their alignment without furniture. Future studies must address postural education in a multidimensional way. This would provide education to students on how to orient their posture optimally to the effects of gravity, backpack safety and ergonomics while providing opportunities for movement to increase core strength and learning engagement.

Sanford's adaptive yoga work with people with disabilities is a relatively new approach that is gaining acceptance in the school and the medical setting (M. Sanford, personal communication, April 23–25, 2010). Participants have not only improved their posture, but also are able to be more independent, breathe better, and speak audibly because of gravity-engaging exercise out of their chairs. The positive feedback from the students lends this type of intervention to future research on the health and fitness benefits of this approach.

Many of the studies exploring how posture affects attention involved adult participants having to multitask while measuring either postural sway or center of pressure (Olivier et al., 2008; Weeks et al., 2003). Concentrating on more than one task negatively impacted posture (Melzer et al., 2001). Perez-Christiaens (1982) pointed out people in postural alignment do not attend to posture because their bodies are in line with

gravity along a plumb line. Being in postural alignment allows you to attend to the task at hand gracefully. As stated previously, only three studies looked specifically at improving children's posture, and none of them looked at the possibility of postural alignment affecting attention to task or learning engagement (Brink et al., 2009; G. Cardon et al., 2002; G. Cardon, De Clercq, & De Bourdeaudhuij, 2000; Dekel & Heyman, 2008). Further, most studies used a technical, medical approach which required a variety of physiological equipment and expertise (Brink et al., 2009; Buderath et al., 2009). For many reasons this is not an approach that can be used in American schools. Doctors could do this type of research, but once children are seeing a doctor there has already been a problem noted. Improving children's posture needs to come from the schools of education programs as a tenet of teacher preparation.

Few studies offered an intervention to address attention to task or learning engagement. One researcher who wanted to address on-task behavior used an electronic device to cue students' attention to task. Proven stimulus response conditioning used in this study may be an effective intervention (Amato-Zech, Hoff, & Doepke, 2006; Skinner, 1988). Could a similar intervention using intermittent frequent reminders be used to improve posture? Since posture is a subconscious response to belong to a group (Lakin et al., 2008), a strong intervention like an electronic reminder is one way to make a change until postural alignment becomes a habit. It would be similar to the posture improving chair design of the Back Straight Boys (Loye et al., 2011).

When a group of researchers asked children why they had back pain, their responses included bad posture and sedentary activities, which was supported by the

scientific knowledge about risk factors (Coleman, Straker, & Ciccarelli, 2009). Children want to be strong and confident; they instinctively know the cause of their discomfort and should be included in developing an effective postural program. Children will be encouraged to mimic the aligned model once they are able to visually distinguish between postural alignment and misalignment. More importantly, the body is designed to move and is never completely still (I. P. Rolf, 1977). Recently, one of the components of Finnish schools, which have been regarded as the top in the world, is that students get plenty of exercise with 15-minute outdoor breaks after every lesson (Hancock, 2011). Taking away recess in hopes of better test scores in the United States may be counterproductive to students' health and academic success.

Several components have to be in place to facilitate a solution to improving postural alignment and learning engagement or attention in the classroom. First, teachers would have to embrace the moving classroom versus static seating (Breithecker, 2008), as Michelle Obama encouraged in her speech in Chicago February 2013. Incorporating movement throughout the day would allow children to keep good spinal health by increasing blood and oxygen flow (Almarode & Almarode, 2008). Second, teachers would need to learn and apply basic ergonomic principles when assigning children to a desk or computer station to reduce any potential back discomfort and improve postural alignment. Third, teachers would need to learn backpack safety recommendations to educate both students and parents about the importance of the national CDC guidelines (National Safety Council, 2009). This would require real-life math activities of calculating weights of students and loaded backpacks to determine if the proper

percentage guidelines (backpacks weighing no more than 10–20% of the students' body weight) were in place (Gart, 2004; Moore et al., 2007). Teaching students about backpack safety may alleviate some of the contributing factors of spinal misalignment. Finally, teachers would need to model and present models of many different people in postural alignment. Providing a postural health education social marketing program through digital storytelling in school and at home may be effective. Educational posters and pamphlets for teachers, students, and parents have been proven effective for other campaigns (Arms et al., 1997; Stellefson & Eddy, 2008). Using a multidimensional approach is the best solution.

Further research of multidimensional interventions is needed to find a possible solution to this current health crisis. The third chapter, *Methods*, will provide a rationale of the research methods chosen for this study. A comprehensive approach to the problem of postural misalignment, increasing learning engagement and improving attention in school-age children is needed. The range of variables for each component lends itself to a mixed-method approach. Both quantitative and qualitative data were collected and examined.

Chapter 3 Research Methodology

Introduction

Mixed methodology was selected to analyze as much data as possible in both the Children's Postural Improvement Study (CPIS) and the Classroom Environmental Study (CES). This research model, which combines quantitative and qualitative approaches was selected to allow for the examination of the impact of the interventions from multiple angles to triangulate an understanding of the research focus (Campbell & Fiske, 1959; Fraenkel, Wallen, & Hyun, 2011). It is important to find the multiple perspectives of the students and staff to learn the reason behind any noted change of their behavior in the limited time of the intervention. *Triangulation* is the term used for homing in on an intervention from multiple perspectives in order to verify your findings (Creswell, 2008). Using theoretical triangulation allows for several frames of reference when analyzing the data, whereas the methodological triangulated designs allow for using dissimilar data collection techniques to study the same intervention (Hoskins & Mariano, 2004). By focusing on many components of the same intervention and triangulating these quantitative measures, and asking the deeper qualitative questions (see Appendix G), the effect of the intervention and what participants valued can be better understood (Fraenkel et al., 2011). Knowing the participants' perspective will be helpful in framing any future studies and pinpointing the essential components to explore.

Quantitative methods organize data for statistical analysis, while qualitative methods look for general themes which emerge and present the complexity of the central

phenomenon (Creswell, 2008). The mixed-method approach allows the researcher to identify the extent of change (quantitative) along with interrelated themes of the changes (qualitative).

When the null hypotheses of the CPIS (Posture does not change as a result of postural or nutritional interventions. Attention does not change as a result of improved postural alignment) were not rejected, the goal for the CES was to take baseline observational data to determine the current state of movement in eight fourth-grade classrooms. An additional goal was to find what multidimensional attributes were in place in the public school setting and to determine if the classroom environments, movement, ergonomics, or posture affected learning engagement. The purpose of CES was to find out what was the state of the current classroom base on the aforementioned factors.

Due to the limited time of both the CPIS intervention and the CES, it was important to find the multiple perspectives, through mixed methodology, of participants to learn the reason behind the change of the participants' behavior. Statistical analyses of the observed quantitative factors of the current experimental research were combined with an ethnographic qualitative view to apply the mixed-method approach in both studies.

Research Design of the Children's Postural Improvement Study (CPIS)

Overview.

The participants include students in two private schools in the Fairbanks area. All classes were part of a convenient sample available and willing to participate in this experimental study (Creswell, 2008). Due to the mixed aged classrooms at School One, all three classes were designated as posture classes. The two classrooms at School Two were randomly assigned to either postural intervention or nutrition intervention.

All participants had a 30-minute presentation on either posture or nutrition daily for 5 days. Participants were receptive and interested in the topics. Before the results were analyzed, teachers were eager to weigh in on the effects of the interventions, and I asked them to share their insight on the post-evaluations.

School and research participants.

The schools were selected based on availability and willingness to participate. Principals asked their teachers who would like to participate. Three teachers from one school and two from another agreed to participate in the study. The research took place in five classrooms in two private educational schools. Table 3.1. illustrates the following: at School One, three classrooms participated: a fifth/sixth-grade combination (8 students), a seventh/eighth-grade combination (10 students), and a ninth-grade (13 students). At School Two, two fifth-grade classrooms participated (8 and 14 students).

Table 3.1. *Number of Students and Grade Level at Each Setting*

Number of Students	School One		Number of students	School Two	
	Grades	Intervention		Grades	Intervention
9	5th/6th	Postural	8	5th	Postural
10*	7th/8th	Postural	14**	5th	Nutrition
13*	9th	Postural			

Note. * = One moved ** = One withdrew

Demographics.

A total of 54 students, consisting of 27 females and 27 males participated in the study. The ethnic breakdown was 47 Caucasians, 3 African Americans, 2 Hispanic, 1 Asian, and 1 Alaska Native (see Table 3.2.). All five teachers who participated in the study were Caucasian females.

Table 3.2. *Demographics*

	5th/6th Grade	7th/8th Grade	9th Grade	5th Grade Nutrition	5th Grade Posture	Total N=54
Gender	4 F 5 M	6 F 4 M	5 F 8 M	6 F 8 M	6 F 2 M	F 27 M 27
Ethnicity	7 C	10 C	1 AN 2 AA 10 C	1 AA 13 C	1 SI 7 C	1 SI 1 AN 2 H 3 AA 47 C

Note. F—Female, M—Male, AN—Alaska Native, IN—American Indian, SI—Asian, H—Hispanic, AA—African American, C—Caucasian

Once consents and assents (see Appendices H, I, J) were signed, parents of the participating students were asked to complete a Partial Vanderbilt ADHD Diagnostic Parent Rating Scale (see Appendix K) and teachers were asked to complete a Partial Vanderbilt ADHD Diagnostic Teacher Rating Scale (see Appendix L) for each student. Both rating scales included a request for a brief written summary of any noted changes on each student pre- and post-intervention. The Partial Vanderbilt ADHD scales were chosen over other rating scales for their ease of administering by eliminating interviews, the ease in gleaning uniform subject data, and the scales' consistency with the DSM-IV measures for ADHD; in addition, approval was granted for using the partial scale, and the measure was cost-free (Wolraich et al., 2003).

Before the intervention began, students were photographed from the side in sitting and standing positions. After the intervention, post-photographs were taken in the same sitting and standing positions using the same chairs in the same location in each of the classrooms. The purpose of photographing the students was to compare their posture pre- and post-intervention to determine if their posture improved, stayed the same or worsened. Three people who have spent years studying posture and teaching others how to improve their posture were recruited to be non-biased judges to determine how the posture changed. These expert raters looked at all photographs to determine how the participants' posture changed after the intervention. It was also essential when determining the null hypothesis: "There will be no significant changes in posture or attention of the students who participated in the postural and nutrition intervention groups." Using student photographs is an accepted practice; a recent study in South Africa compared pre- and post-photographs of its participants to measure the angle of misalignment associated with upper quadrant musculoskeletal pain participants reported (Brink et al., 2009). The photographs in the CPIS were taken to document any change in postural alignment to determine if the postural education had any beneficial effects.

Students were also given a timed math fluency assessment (see Appendix M) to determine their attention to detail pre and post-intervention. The hypothesis is improved posture will improve attention. Using this performance measure allows a triangulated comparison of attention from participants, parents' perspective, and teachers' perspective. This in conjunction with the Partial Vanderbilt ADHD Diagnostic Parent Rating Scale and the Partial Vanderbilt ADHD Diagnostic Teacher Rating Scale, which were used to

validate any change in attention through both a performance measure and an observational method. The 80 problems, a common amount found on achievement and intelligence tests, of the math fluency test were below fourth-grade level. Once the test was handed out the following directions were read:

I want you to work some simple math problems. Start here. (Point to the top left problem.) When you finish a row, go to the next one and work each problem until you finish the page. Then turn your page over and go to the top of the next page. If you cannot think of an answer, skip that item and move on to the next one. Work as fast as you can without making mistakes. Be sure to watch the signs. If you do make a mistake, just cross out the answer you do not want. You will have two minutes. Tell me if you finish before I say, “Stop.”

The students in the classroom who received nutritional training versus postural training were also given an additional pre- and post-nutrition test for their nutrition unit (see Appendix N). This was to determine if the students in this group would show any significant change in performance due to their nutrition education (Creswell, 2008). Students in the postural group were given a post-survey about the postural intervention (see Appendix O).

Parental consent and assent.

The rise in ADHD diagnoses raises concerns in the classroom regarding student achievement and behavior, and consequently researchers are looking for solutions (Amato-Zech et al., 2006). Parents not only want their children to be able to be successful

in school, pay attention, and have a positive learning experience, but they would also like them to have a healthy posture (Goldstein, 2010; Polanczyk, Silva De Lima, Horta, Biederman, & Rohde, 2007).

The CPIS followed the Institutional Review Board (IRB) procedures. After IRB approval a consent/assent form for the postural intervention portion of the CPIS asked parents and students to agree to take part in a study about paying attention (see Appendix H).

Teacher consent.

Teachers rated quantitatively the students' behavior pre- and post-intervention, and qualitatively how the study impacted both the students and their classroom. The teachers filled out a survey about how well their students paid attention at the beginning and end of the study (see Appendix L). They completed a questionnaire/brief written response noting any changes in their students (see Appendix P). They rated the impact of instruction on the classroom using a rating scale, and they documented what they did to remind students of the importance of correct postural alignment.

Implementation of the study.

Postural intervention.

The need for an intervention has been documented in the previous literature review (Chapter 2). European researchers successfully used an educational approach to change postural patterns of school-age children (G. M. Cardon et al., 2007; Dekel &

Heyman, 2008). I wanted to see if similar results could be found using slightly different interventions while measuring attention at the same time.

Correct postural alignment was taught to children in three classrooms, grades five/six, seven/eight, and nine at one private school, and to one fifth-grade class at the other private school. Two phases were implemented after the pre-tests and pre-photographs were taken. Phase one included an educational component of five 30-minute postural educational presentations, demonstrations, and practice sessions during a one-week time frame. The postural topics covered were: hip hinging or bending without collapsing the spine, sitting, standing, walking, and a review. In other postural interventions students were taught similar topics as well as backpack safety (G. M. Cardon et al., 2007; Dekel & Heyman, 2008). Participants had never considered their posture previously and were open to the instructions, asked good questions, and began to observe the people around them.

Phase two included visual representations (posters) of desired spinal alignment and demonstrated proper bending, sitting, standing and walking. Each poster had two or three examples of children and adults in these positions while maintaining postural alignment. The posters were displayed prominently on the classroom wall. In addition, a laptop computer was placed at the front of the classroom with 16 desired spinal alignment representations and 16 positive and encouraging verbal messages (see Appendix A) to help the student find the desired spinal alignment. It played every 20 minutes on the classroom computer throughout the research period. At the beginning of the reminder messages, the teacher referred students to the posters and the PowerPoint visual models

until the students learned to reposition their seated posture independently. These reminder messages were used for a period of 30 to 45 days. The difference in length was due to the many school activities and the scheduling of the post-intervention testing close to the winter break.

Nutritional intervention.

A nutritional intervention was also discussed in Chapter 2. Nutrition as a means to improve posture was taught to one class in School Two. One fifth grade class received a nutritional education unit developed by the USDA that included a 30-minute period of instruction each day for a week. The students in the nutritional intervention classroom took both a pre- and post-math fluency test and a pre- and post-nutrition test consisting of 21 questions (see Appendix N).

Data collection.

Quantitative assessment.

The quantitative approach uses statistical analyses such as Descriptive Statistics, One Sample T-Test, analysis of covariance (ANCOVA), and Chi-squared tests, it also answers the first research question: “Does improved postural alignment improve attention in school-age children?” All the classroom teachers rated each student’s attending behavior pre- and post-intervention using the Partial Vanderbilt ADHD Diagnostic Teacher Rating Scale (see Appendix L) (S. Braaten, personal communication, September 25, 2009) (Wolraich et al., 2003).

Parents from all the classrooms were asked to rate their child's attending behavior pre- and post-intervention using the Partial Vanderbilt ADHD Diagnostic Parent Rating Scale (see Appendix K). An important factor to understand when using this measure is the difference between "no pre-/post-behavioral indicators" and "no change in behavior." Students who are attentive to the educational process will have no behavioral indicators. Students who may have poor attending behaviors may have the same poor attending behaviors pre- and post-intervention and will be classified as having no change in behavior even when they do have trouble attending.

Postural experts, two of whom are certified Balance instructors and one who has participated in three Balance instructor intensive training classes, completed pre- and post-photographic ratings. All three of these experts have participated in ethnographic studies with Noelle Perez in Paris. Additionally, they have created centers to teach postural alignment in the United States. Each expert was given the following directions to follow when rating the pre- and post-photographs:

Directions for Rating Postural Alignment

Unfortunately these pictures are taken at various angles and distances; students are wearing various clothing and hairstyles; and various chairs were used in each classroom. Please compare the Pre (top) pictures to the Post (bottom) pictures. Indicators to look for in the standing photos are the alignment (plumb line) of the head (ears), shoulders, hips, knees and ankles. Indicators to look for in the sitting position photos is the alignment (plumb line) of the head (ears), shoulder and hips; student is

sitting on their sit bones (sitting up) vs. tail bone (slouching on spine); and the student's feet are flat on the floor. If there is an improvement (more indicators present) mark +1, if there is no change mark 0, and if there is a decrease (less indicators present) mark -1.

Ratings of the sitting and standing pre- and post-digital images were checked for inter-rater reliability using the Pearson Correlation analysis. The correlation was significant to the 0.05 level (two-tailed) for raters 2 and 3 for the sitting images. Rater 1 was marginally significant to the 0.054 level (two-tailed) compared to rater 2. For the standing images the inter-rater reliability between rater 2 and rater 3 was significant to the 0.01 level (two-tailed) using the Pearson Correlation analysis.

The math fluency test consisted of a variety of 160 single-digit problems that were mixed operations of addition, subtraction, multiplication, and division. It was not necessary to provide additional instruction in order for them to complete the worksheet during the two-minute test period because the fluency worksheet was below the students' grade level. By design, the mathematical operations were mixed in order to determine students' attention to task (L. J. Gibson, personal communication, March 5, 2010). The number of correct answers was recorded pre- and post-intervention. Once the pre-assessments were completed, students took part in the education intervention.

The post-Likert portion of the Post Student Survey Postural Alignment Group (see Appendix O) was developed by the researcher to determine students' opinion and attitude about the intervention (Creswell, 2008). The study could be replicated because

the impact of the study in the classroom was not a burden. The survey consisted of the following statements:

1. The five days of 30 minutes of posture instruction were helpful.
2. The reminder message like “sit tall” that played every 20 minutes were helpful.
3. This posture instruction made it easier to pay attention.
4. This posture instruction made it easier to complete tasks.
5. This posture instruction made it easier to sit strong.

Students rated their level of agreement to the five statements with: Strongly Agree, Agree, Neutral, Disagree, or Strongly Disagree.

The post-Likert portion of the Post Teacher Survey Impact of Postural Alignment Instruction (see Appendix P) was developed by the researcher to determine teachers’ opinion about the impact of the intervention. The survey consisted of the following six statements:

1. The initial five days of 30 minutes of instruction were beneficial.
2. The reminder messages like “sit strong” that played every 20 minutes were helpful.
3. Filling out the pre- and post-Vanderbilt ADHD Diagnostic Teacher Rating Scale and the post brief written summary of any noted changes on each student was helpful.
4. This intervention made a positive impact on my students’ ability to pay attention.
5. This intervention made a positive impact on my students’ ability to complete tasks.

6. This intervention made a positive impact on my students' postural alignment.

Teachers rated their level of agreement to the six statements with: Strongly Agree, Agree, Neutral, Disagree, or Strongly Disagree.

A summary of the research questions, data sources and methods of analyses follows (see Table 3.3.).

Qualitative assessment.

The students were provided with these questions to determine their involvement and interest in the study. If this intervention would be used in classrooms in the future it is important to determine students buy in to the activities, to be responsive to the students' questions and to encourage engagement. After the daily instructional intervention each student answered the following questions:

1. What did you learn today?
2. Why do you think this is important?
3. What questions do you have?
4. What else do you want to know?

This allowed a qualitative insight into the research participants' concerns, thoughts, and feelings as well as providing an avenue for daily discussion between the researcher and the participants (see Appendix Q). Starting the presentation with questions and answers from the previous day was effective to review the previous day's lesson, invite future questions, and keep students engaged in the current lesson.

Students completed surveys requiring brief written responses, about what they liked or did not like about the intervention (see Appendix O). They were asked open-ended Posture Follow-up Questions (see Appendix G) to note any changes they experienced during the intervention period. These qualitative questions were asked to determine the participants' internal thoughts regarding this intervention, posture, and paying attention in school. The questions were:

1. What have you noticed about other people's posture?
2. How have you changed your posture?
3. What changes have you noticed in the way you interact with others?
4. How has your ability to focus changed?
5. How does your posture change when you are at home, school, or in the community?
6. What are your thoughts about your posture being affected by people or the environment?
7. If you change your posture when you want to remember what people are saying, what are the changes you make to help you pay attention?
8. Do you have any other thoughts on the posture lessons you would like to share?

Teachers had the opportunity to write any comments on the Post Teacher Survey Impact of Postural Alignment Instruction (see Appendix P) and on the same open-ended Posture Follow-up Questions (see Appendix G) that the students responded to noting any changes they experienced during the intervention period. Teachers had the opportunity to

share important information affecting future research designs when they described the impact the intervention had on themselves, their students, their classroom, and their time.

A summary of the research questions, data sources, and methods of analyses is documented in Table 3.3.

Table 3.3. *Research Methods*

Research Questions	Data Sources	Methods of Qualitative/Quantitative Analyses
To what extent does the postural or nutritional intervention improve posture?	Pre- and Post-Photographs	Expert raters Descriptive statistics One Sample T-Test
To what extent does improved postural alignment improve attention in school-aged children?	Pre- and Post-Partial Vanderbilt ADHD Parent Rating Scale Pre- and Post-Partial Vanderbilt ADHD Teacher Rating Scale Pre- and Post-Math Fluency tests Student Post Surveys Teacher Post Surveys Student Post-Open-ended questions Teacher Post-Open-ended questions	Descriptive statistics ANCOVA Chi-Square tests Triangulation
To what extent do participants value posture and want to make a change?	Student Post Surveys Teacher Post Surveys Student Post-Open-ended questions Teacher Post-Open-ended questions	Descriptive statistics Triangulation
To what extent does the intervention provide enough education for participants to change their postural alignment?	Student Post-Open-ended questions	Descriptive statistics Triangulation
How much leaning, standing up and movement are allowed in the classroom during three one-hour observations?	Classroom Observations and data collection	Chi-square tests Descriptive statistics Triangulation SAS General Linear Models Two-way ANOVA Post-hoc Tukey Standardized Range Test
What ergonomic options are available to students?	Classroom Sketches	Chi Square tests Descriptive statistics Triangulation
To what extent does classroom layout lend itself to student movement?	Classroom Sketches	Coding Chi-square tests Descriptive statistics Univariate ANOVA

Data analysis.

Five classrooms received an intervention, four had a posture training intervention and one had a nutrition training intervention. There were 54 students total who began the study; due to absences and special events a range of 40-50 students completed each of the three groups of variables (pre- and post-math fluency, teacher ADHD scales, and postural photographs).

A total of 45 students completed both the pre- and post- math fluency test. These are continuous measures with possible scores from one to 160. The expectation was that students would perform better after the intervention based on the hypothesis that improved postural alignment would improve students' attention to task.

Teacher ratings of 10 attention indicators on the pre- and post-Partial Vanderbilt ADHD scale were completed on 50 students. The hypothesis was that improved postural alignment would improve attention and the scores of this scale would decrease after the intervention. In this convenient sample it is clear that both the pre-and post-ADHD ratings had a significant number of students without any indicators present.

Postural alignment was measured in both the standing and sitting position using pre- and post-photographs rated by three expert raters. Only 40 students were available for both photographs in both the postural and nutrition intervention groups. Posture was rated +1 for improve, 0 no change, and -1 for posture worsened. The hypothesis was that the postural and nutritional interventions would improve posture.

Initially, the experimental design was going to compare the results of both interventions. However, only one classroom was available for the nutritional intervention, which made the statistical inference less reliable and only justified a very cautious interpretation. In order to statistically examine the data, SPSS software was used for a variety of analyses. A one-way ANOVA compared the outcome variables (math fluency and teacher ADHD scales) with intervention as a factor. If the interventions did not have an effect on the outcome variables than all classes within each intervention (postural and nutrition) were grouped together to examine pre-post measurement differences. This approach informed any correlation between improved attention and improved posture for individual subjects. The only difference among interventions was the pre-math fluency assessment, but it was correlated with the post-math fluency test and this justified a covariate analysis as it was significantly different at the start.

Correlations between pre- and post-math fluency showed a strong correlation (Pearson correlation = 0.841 $p = 0.01$); which allowed the use of the pre-math fluency scores as a covariate when the post-math fluency scores are used as the dependent variable in an ANCOVA. A strong correlation between the teacher ADHD pre- and post-ratings (Pearson Correlation = 0.819, $p = 0.01$) was evidence to use the pre-ADHD scores as a covariate when the post-ADHD scores are used as a dependent variable in an ANCOVA. No correlation between pre- and post-posture ratings allowed both to be used as independent variables.

To answer research question one, “To what extent does the postural or nutritional intervention improve posture?” the analysis looked at posture outcome measures given the intervention. This analysis process uses pre- and post-photographs rated by three experts. Scores were averaged over the three expert raters and then regrouped in one of three categories: improve, no change, or worsened. To determine if the gain score is statistically significantly different from zero, a T-Test using both the standing and sitting posture ratings as independent variables was run comparing the mean to zero.

To address research question two, “To what extent does improved postural alignment improve attention in school-aged children?” the analysis of covariance looked at the attention measures (ADHD Teacher Rating Scales and Math Fluency tests) given the posture data. The ANCOVA was run twice. First, with the post-ADHD teacher rating scale as dependent variable, the pre-ADHD teacher rating scale as the covariate both formatted as continuous variables, and the independent variables change in standing rating and change in sitting rating formatted as ordinal data (-1, 0, +1). Improvement with this score would be a decrease in the Post-ADHD teacher rating (less indicators of poor attention). Secondly, with the post-math fluency as dependent variable, the pre- math fluency as the covariate both formatted as continuous variables, and the independent variables change in standing and sitting formatted as ordinal data. In this case improvement would be an increase in the post-math fluency score (completing more math problems correctly). Results also showed if standing or sitting posture had more of a decrease in attention indicators (ADHD rating scale) or more of an increase in attention to task (math fluency).

To address research question three, “To what extent do participants value posture and want to make a change?” and research question four, “To what extent does the intervention provide enough education for participants to change their postural alignment?” responses to the survey data were used.

Using the mixed methods approach to this study requires analyzing all aspects of the intervention and triangulating the results to determine significance (Creswell, 2008). In this multidimensional design, each data set may confirm the hypotheses more than once.

Research Design of Classroom Environmental Study (CES)

Overview.

The researcher sketched the classroom layout in each of the three local elementary schools. Anecdotal notes were recorded when teachers, who were present, had questions or comments regarding room arrangement and student movement. Observation of eight fourth-grade classrooms took place on three separate occasions for a period of one hour to determine the amount of student leaning, standing up, and movement during the observational time and was collected on Behavior Tracking Pro (BTP), an iPhone application. Observations occurred in random order when the researcher had blocks of time and classrooms were in session; students were not at music, physical education, or other special activity. Order of observations for each school was determined by using a randomized number generator as was the order of classroom observations at each school. Field notes were used to record the activities students were engaged in during the

observation time. Demographic information was not collected since the research was observational only. The null hypotheses for the CES are:

1. Student leaning, standing up, and movement are not different between classrooms.
2. Student leaning, standing up, and movement are not different between schools.
3. Ergonomic options are not different between classrooms.
4. Ergonomic options are not different between schools.
5. Student movement is not different because of classroom layout.

Data collection.

Sketches.

Sketches of the classroom layout were completed after school when students had left for the day. Sketches provided a visual representation of the classrooms to analyze when coding and reviewing the results (see Appendix E) (Gislason, 2009). I coded and recoded these sketches multiple times before deciding on the most vital aspects of classrooms. Important themes surfaced through the process of recoding data multiple times (Strauss & Corbin, 1990). Sketches along with the field notes of activities from the observed classrooms determined the important attributes of the classroom layout. Through multiple observations and review of the sketches, movement appeared to be affected by the classroom layout.

Occasionally, teachers were present and shared their philosophy on classroom arrangement and student movement. Walking pathways and gathering areas were noted

on the sketches. Seating options were limited to molded plastic static chairs that did not allow movement unless rocked onto one or two chair legs (see Appendix R). In general, the chairs came in four heights and proportional sizes, although limited sizes were available in each room. Any varieties in seating options were noted in the sketches. Most working surfaces for students consisted of individual desks or shared tables. Only one classroom used the connected chair/desk units. Classroom arrangement was compared by school and by grade level using Chi-square tests.

Classroom sketches were also coded by the seating relationship to instructional delivery to see if there was a preferred relationship. Seating relationship to instructional delivery was compared by school and by grade level using Chi-square tests.

Quantitative assessment.

The quantitative approach was used to tally the occurrences of student leaning, standing up, and moving behavior. Leaning was defined as any position that uses body supports to hold up one's head, resting upper body on the desk, or tipping of the chair off one or more chair legs. Standing up was defined as supporting one's body on one or two feet. Movement was defined as moving from one location to another location. Tracking the occurrences in each of the fourth-grade classrooms was done with the BTP application. The application provides a stopwatch to indicate start time of observation, and the three behaviors were easily identifiable buttons. After each hour the number of occurrences of each behavior were recorded in a field notebook. Since students came and went during the 1-hour time period, the data was normalized for the number of

occurrences per the average number of students present during each observation period. Normalizing data is a common research practice that allows comparison of data when there are fluctuations in the subject population (Creswell, 2008). The averages per classroom (\pm the standard error of the mean (SEM)) are reported. Normalized data allowed comparisons of classrooms within a particular school, comparisons among schools, as well as comparisons of all classrooms for each behavior type under study using SAS statistical analysis. Further tests determined if there was any correlation between leaning, standing up, and moving. Full class movement (FCM) involved all students and was teacher directed.

Qualitative assessment.

Qualitative assessment came from a variety of sources: anecdotal comments from teachers; this researcher's reflections on classroom activities and their effect on student leaning, standing up, and moving behavior; and whether certain behaviors were connected to learning engagement, student disinterest, or classroom arrangement.

Field notes included description of individual movement versus FCM, posture, the placement of students' feet during different activities, ergonomics, and learning engagement. Overall observations, trends noted in classroom layout, as well as common themes within classrooms and schools were described. This ethnographic approach is common in the educational setting, as it does not disrupt with the educational process. Teachers use observational data to inform their practice continually.

Data analysis.

The seating options were statistically evaluated by a Chi-squared test for expected distribution of differences among the three schools. The leaning, standing up, and moving data were evaluated with a SAS General Linear Models (GLM) procedure two-way analysis of variance (ANOVA) for school and classroom within school effects, followed by a post-hoc Tukey standardized range test if significance was found. Linear correlation coefficients between standing and moving, leaning and moving, and leaning and standing were obtained and significance determined with Table 9.2 in Neave (Neave, 1978).

These studies have been conducted with a small sample size, but the data has been analyzed both quantitatively and qualitatively. The significant findings are supported through triangulation of the mixed-method approach (Teddle, Tashakkori, & Johnson, 2008).

IRB approval.

Both studies received IRB approval. Students, parents and teachers in the CPIS signed the appropriate consent and assent forms. Students not wanting to participate had alternative activities during the intervention time. The observational nature of the CES was done in cooperation with the classroom teacher who designated where to sit without disrupting the educational process. The researcher maintained the highest level of ethical consideration in both studies (see IRB Approval, Appendices C, D, E).

Summary

This chapter discussed the methodology of both the CPIS and the CES and outlined the studies' participants, research design, intervention and observation procedures, and data collection and analysis procedures. The following chapter, *Results*, presents the data analysis and findings of the study.

Chapter 4 Results

Children's Postural Improvement Study (CPIS) Introduction

In chapter 3, the mixed-methodological approach of the CPIS was outlined. Data from the CPIS can be further divided into 10 sections: 1) Pre- and Post-Partial Vanderbilt Parent Ratings; 2) Pre- and Post-Partial Vanderbilt Teacher Ratings; 3) Pre- and Post-Math Fluency results; 4) Pre- and Post-Photographic Ratings; 5) Pre- and Post-Nutrition test results; 6) Student Post-Surveys; 7) Teacher Post-Surveys; 8) Post open-ended questions on the Student Surveys; 9) Post open-ended questions on the Student and Teacher Surveys; and 10) Students' daily response noted on the Exit slips.

Data return rate varied considerably. It was impossible to collect data on all 54 original students since two students moved, one from the seventh/eighth-grade posture group and one from the ninth-grade posture group. In addition, one student withdrew from the fifth-grade nutrition group. Data from parents was also inconsistent; 35% of the parents completed only the pre-survey or only the post-survey or did not respond to either one. Another area of missing data was due to student absenteeism, which affected some pre- or post-math fluency tests or pre- or post-photographs. Data findings for Partial Vanderbilt Teacher Ratings, Pre- and Post-Math Fluency results, and Post-Photographic Ratings can be found in Appendix S. Given these challenges, the following section provides the resulting response rates for each area of data collection.

Partial Vanderbilt ADHD Parent Rating Scale results.

The return rate for the Partial Vanderbilt ADHD Parent Rating Scale was very low (Table 4.1.). The return rate ranged from 0% to 89% for the grade levels participating in the postural intervention and was only 23% for the nutrition intervention. The overall average return rate was 39%. The data size was too small to make meaningful comparisons for analysis.

Table 4.1. *Partial Vanderbilt ADHD Parent Rating Scale Completion Rate*

	5th/6th Grade	7th/8th Grade	9th Grade	5th Grade Nutrition	5th Grade Posture	Total N=51
Completion	2/9	8/9	7/12	3/13	0/8	20/51
Rate	13%	89%	58%	23%	0%	39%

Partial Vanderbilt ADHD Teacher Rating scale.

The response rates from the Partial Vanderbilt ADHD Teacher Rating Scale were adjusted for all classes by reducing the sample sizes due to students moving or withdrawing from the study. As shown in Table 4.2., the total return rate from teachers was 98.04% or 50 out of 51 possible completions.

Table 4.2. *Partial Vanderbilt ADHD Teacher Rating Scale Completion Rate*

	5th/6th Grade	7th/8th Grade	9th Grade	5th Grade Nutrition	5th Grade Posture	Total
Completion	9/9	9/9	12/12	12/13	8/8	N=51
Rate	100%	100%	100%	92%	100%	98.04%

Twenty-eight, or (55%) of the 51 returned rating scales indicated no pre- and post-behavior indicators on the scales and thus also no change in behavior indicators. Of the remaining students, 11 out of 51 (21.6%) of the students rated with at least one non-attending behavior less in the post-test versus the pre-test. Eight students (15.7%) of the total number of students were rated with at least one additional non-attending behavior in the post-test. Three students (5.9%) did not show a change in the non-attending behaviors. One student (2%) did not have a post-survey.

Comparing the postural intervention Partial Vanderbilt Teacher Rating scale 15 out of 38 students (39.5%) showed a change in non-attending behavior. Nine (23.7%) had less non-attending behaviors noted in the post-test, while six (15.8%) of the students increased their non-attending behaviors. The remaining 20 students (52.6%) had no indicators of non-attending behavior pre- and post-intervention and three showed no change.

Although these frequencies are too small to analyze statistically, here is a brief description of the results of the Partial Vanderbilt Teacher Rating scale in the nutrition intervention. The majority of students, 8 out of 13 (61.5%) had no non-attending

behavioral indicators. One (7.7%) had no post-scale. Of the remaining four participants (30.8%) who had non-attending behavioral indicators as defined by the rating scale, two (15.4%) increased their non-attending behaviors and two (15.4%) decreased their non-attending behaviors (Table 4.3.).

Comparing classes within the posture group using Chi Square analysis that all classes would be similar; findings were classes did not differ in the Partial Vanderbilt ADHD Teacher Rating Scale changes ($X^2_3 = 3.289$, $p > 0.6$).

Table 4.3. *Partial Vanderbilt ADHD Teacher Rating Scale Results*

	No Pre/Post- Behavior Indicators	No Change in Behavior	Decrease in Non- Attending Behavior Indicators	Increase in Non- Attending Behavior Indicators	No Post- Scale	Total
All Participants	55%	5.8%	21.6%	15.6%	2%	100%
Postural Intervention Participants	23.7%	7.9%	52.6%	15.8%	0%	100%
Nutrition Intervention Participants	61.5%	0%	15.4%	15.4%	7.7%	100%

Figure 4.1 Pre-Partial Vanderbilt ADHD Teacher Rating Scale Results and Figure 4.2. Post-Partial Vanderbilt Teacher Ratings illustrate how there are a significant number of students who had no ADHD indicators (Value of 0) at the beginning and at the end of the study. This could be a factor related to this small convenient sample of students who are attending private schools and whose parents are responsible for tuition costs.

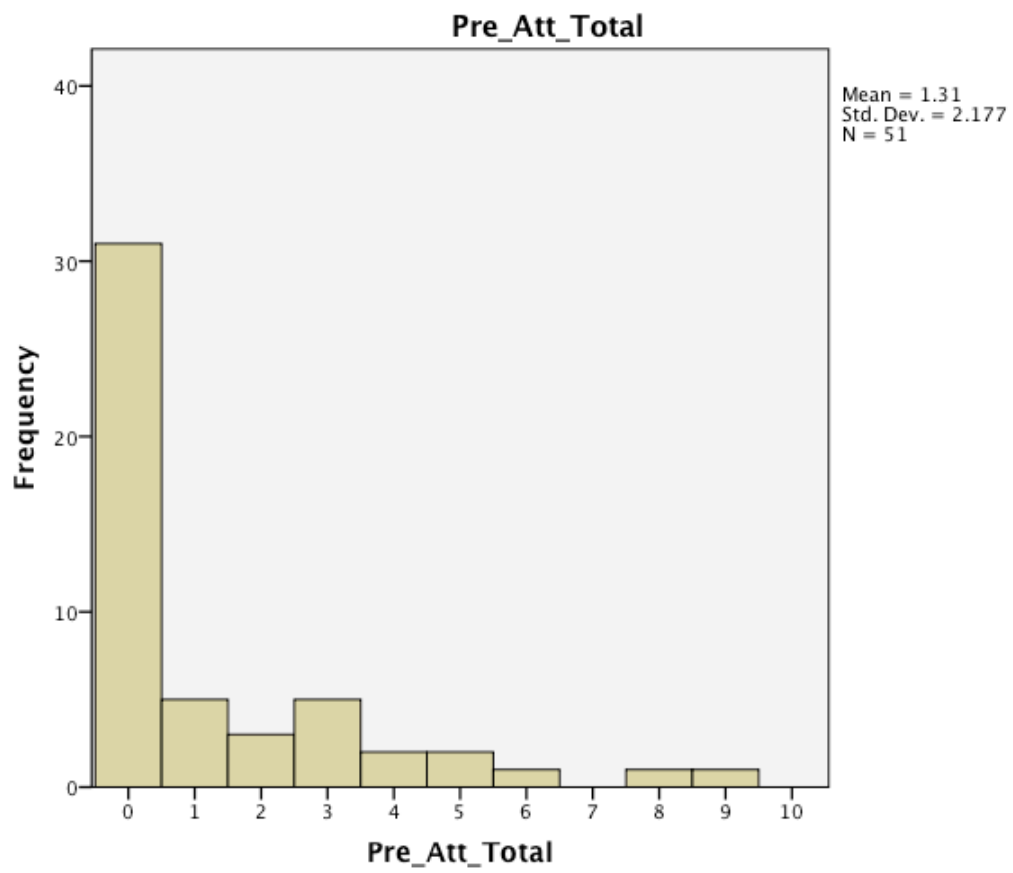


Figure 4.1. *Pre-Attention Frequencies*

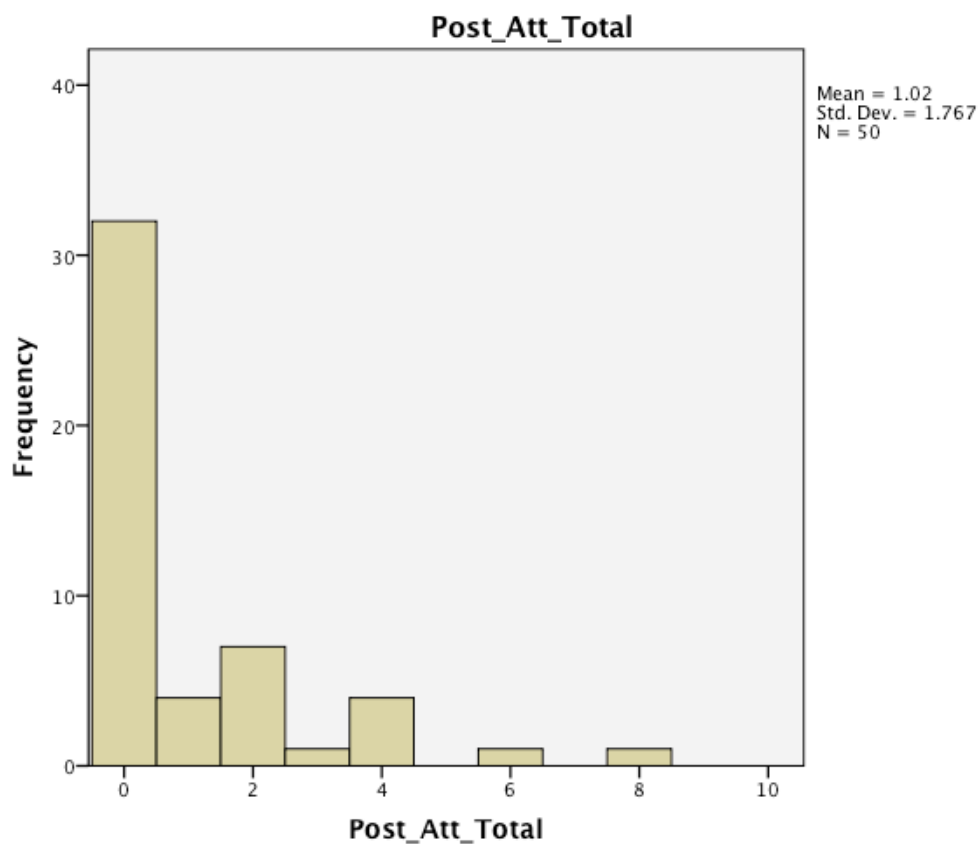


Figure 4.2. *Post-Attention Frequencies*

Table 4.4. shows the descriptive statistics for the Partial Vanderbilt ADHD Teacher Rating Scale Results compared to the postural and nutritional interventions. There were 38 in the postural intervention and 12 in nutritional intervention for a total of 50 students.

Table 4.4 *Descriptive Statistics of the Teacher ADHD Rating Scale*

Intervention		Pre-Rating	Post-Rating	Change in Rating
Posture	N	39	38	38
	Mean	1.4	1.1	-.2
	Std. Deviation	2.3	1.9	1.0
Nutrition	N	12	12	12
	Mean	.92	.9	.00
	Std. Deviation	1.9	1.4	1.3
Total	N	51	50	50
	Mean	1.3	1.0	-.2
	Std. Deviation	2.2	1.8	1.1

Using the one-way ANOVA to evaluate variables (ADHD indicators) with intervention as a factor neither the pre- or post-Partial Vanderbilt ADHD Teacher Ratings were significant (between groups $F = 0.517$, $df = 1$, $p = 0.476$).

To address research question two, “To what extent does improved postural alignment improve attention in school-aged children?” the analysis examined the pre- and post-ADHD Teacher Rating Scale given the change in standing and sitting posture data. Neither the change in standing posture ($X^2_2 = 1.531$, $p = 0.216$) nor the change in sitting posture ($X^2_2 = 1.868$, $p = 0.393$) were significant, hence postural alignment did not effect attention in this instance.

Pre- and post-math fluency results.

During the post-test, students received explicit verbal directions to start on the first side of the page for the pre-test. Only nine students in the posture study and ten students in the nutrition group followed those instructions. The problems on the second side were harder than the first side, and students generally scored much lower. Therefore, these students were excluded from the analysis. Five students were absent either on the day of the pre-test (2) or the post-test (3). One student from the nutrition intervention withdrew from the study.

The mean change in fluency for the students in the posture study was 6.56 ± 1.35 . Results ranged from -4 to $+15$. In the nutrition group, fluency improved from $+1$ to $+13$, with a mean of 7.90 ± 0.98 points. A one-way ANOVA of the pre- and post-math fluency to test for classroom affect was performed. The difference between classes was significant ($F_{4,40} = 11.203$, $p < 0.0001$).

A paired sample t-test for pre- and post- difference for both postural intervention and nutrition intervention proved significant in four out of the five classrooms (see Table 4.5.). The mean \pm standard error for each pair in sequential order are: 5th/6th grade posture 8.63 ± 3.95 ; 7th/8th grade posture 5.71 ± 4.44 ; 9th grade posture 9.40 ± 2.36 ; 5th grade posture 18.38 ± 4.46 ; and 5th grade nutrition 9.58 ± 1.73 . Fifth grade posture mean is different from the others. Students taking this measure in different ways made it difficult to draw any conclusions except that procedures for implementing the test need to be more explicit.

Table 4.5 *Paired Samples t-tests for Math Fluency by Class comparing pre- and post-scores.*

Classroom	t value	df	p Value
5 th /6 th Grade Posture	2.181	7	0.0001
7 th /8 th Grade Posture	1.287	6	0.023
9 th Grade Posture	3.986	9	0.001
5 th Grade Posture	4.124	7	0.129
5 th Grade Nutrition	5.555	11	0.0001

Table 4.6. illustrates the descriptive statistics for the pre- and post-math fluency as compared to both the postural and nutrition interventions. There were 33 students in the postural intervention and 12 students in the nutritional intervention for a total of 45 who completed both the pre- and post-math fluency tests in order to have a change in score.

Table 4.6. *Descriptive Statistics of Math Fluency*

Intervention		Pre_Math	Post_Math	Gain_Math
Posture	N	36	37	33
	Mean	66.7	69.0	4.0
	Std. Deviation	22.1	22.2	15.0
Nutrition	N	12	12	12
	Mean	45.6	55.2	9.6
	Std. Deviation	12.7	12.8	6.0
Total	N	48	49	45
	Mean	61.4	65.6	5.5
	Std. Deviation	22.1	21.1	13.4

Using the one-way ANOVA to evaluate variables (pre- and post-math fluency) with intervention as a factor, there was a significant result (pre-math fluency $F = 9.80$, $df = 1$, $p = 0.003$, post-math fluency $F = 4.139$, $df = 1$, $p = 0.048$). However, the pre- and post-math fluency tests are correlated, hence the pre-math fluency can be used as a covariate and the post-math fluency can be used as the dependent variable in an ANCOVA with the change in standing and sitting posture as independent variables.

To address research question two, “To what extent does improved postural alignment improve attention in school-aged children?” the analysis examined pre- and post-math fluency tests given the change in standing and sitting posture data. Using the Generalized Linear Models the Omnibus Test shows the correlation is significant at $p = 0.01$ level insuring the ANCOVA is a good model to use to evaluate this data. The Tests of Model Effects using the Wald Chi-Square indicate the change in sitting posture had a borderline positive significance on math fluency ($X^2_2 = 5.847$, $p = 0.054$ which is

significant to the 94.6%). Results for change in standing, also positive, ($X^2_2 = .0.933$, $p = 0.627$) was not significant.

Pre- and post-photographic ratings results.

Experts ratings of the pre- and post-sitting and standing photographs of the students in the postural intervention and the nutritional intervention were averaged by the whole rating value to help determine if there was a change in the postural alignment of the students. For example: if the scores were -1, 0, +1 the average would be 0; if the scores were +1, 0, +1 the average would be +1; and if the scores were +1, 0, 0 the average would be 0 (Table 4.7. and Table 4.8.).

Of the 51 possible students in the study, only 40 students were present to get both their pre- and post-intervention photographs. Two students were missing from the nutrition intervention, and nine students were missing from the postural intervention..

Table 4.7. *Posture and Nutrition Standing Average Post-Intervention Ratings*

Avg. Rating	Posture 5 th Grade	Posture 5 th /6 th Grade	Posture 7 th /8 th Grade	Posture 9 th Grade	Nutrition 5 th	Total
+1	5	4	2	6	9	26
0	1	2	5	2	2	12
-1	0	1	0	1	0	2
N=	6	7	7	9	11	40
<i>Note.</i> +1 = Improved Posture 0 = No Change -1 = Posture Worsened						

Table 4.8. *Posture and Nutrition Sitting Average Post-Intervention Ratings*

Avg. Rating	Posture 5 th Grade	Posture 5 th /6 th Grade	Posture 7 th /8 th Grade	Posture 9 th Grade	Nutrition 5 th	Total
+1	3	4	5	7	7	26
0	2	3	2	2	1	10
-1	1	0	0	0	3	4
N=	6	7	7	9	11	40
<i>Note.</i> +1 = Improved Posture 0 = No Change -1 = Posture Worsened						

Postural ratings are described by intervention for both standing and sitting. The results for the standing position show that the percent of students with improved posture (rating of +1) for the nutrition group was 81.82% and 60.92% in the postural intervention group. The percent of students with no change (rating of 0) for the nutrition group was 12.12% and 31.04% in the postural intervention. The percent of students whose posture

was rated worse (rating of -1) for the nutrition group was 6.06% and 8.04% in the postural intervention group.

The results for the sitting position show that the percent of students with improved posture (rating of +1) for the nutrition group was 57.58% and 67.79% in the postural intervention group. The percentage of students with no change (rating of 0) for the nutrition group was 18.18% and 24.14% in the postural intervention. The percentage of students whose posture was rated worse (rating of -1) for the nutrition group was 24.24% and 8.03% in the postural intervention group. Using the Chi-Square analysis to examine classroom affect in the postural intervention there was no significance in the standing ($X^2_6 = 7.283$, $p > 0.70$) or the sitting ($X^2_6 = 5.273$, $p > 0.60$) positions.

Interestingly, there were students who showed no change but had good posture either sitting or standing. Rater 1 and rater 3 noted two students with good posture both sitting and standing and no change, while rater 2 noted three students with good posture sitting and standing and no change.

Table 4.9. represents the descriptive statistics of the change in standing and sitting posture as compared to both the postural and nutrition interventions. There were 29 students in the postural intervention and 11 students in the nutrition intervention for a total of 40 students. These descriptive statistics also illustrate the variability of complete data sets due to unexpected events.

Table 4.9 *Descriptive Statistics for Posture*

Intervention		Change_Standing	Change_Sitting
Posture	N	29	29
	Mean	0.5	0.6
	Std. Deviation	0.6	0.6
Nutrition	N	11	11
	Mean	0.8	0.4
	Std. Deviation	0.4	0.9
Total	N	40	40
	Mean	0.6	0.6
	Std. Deviation	0.6	0.7

To answer research question one, “To what extent does the postural or nutritional intervention improve posture?” a T-Test using the two independent variables of change in standing posture and change in sitting posture was run. For the postural intervention, standing posture results ($t = 4.396$, $df = 28$, and $p < 0.01$ (two-tailed)) and sitting posture results ($t = 5.953$, $df = 28$, and $p < 0.01$ (two-tailed)) indicate a rejection of the null hypothesis, “Posture does not change as a result of postural or nutritional interventions.” The positive t values indicate that more students did improve their standing and sitting posture in postural intervention.

For the nutrition intervention, standing posture results ($t = 6.708$, $df = 10$, and $p < 0.01$ (two-tailed)) indicate a rejection of the null hypothesis, “Posture does not change as a result of postural or nutritional interventions.” The positive t value indicates that more students did improve their standing posture in the nutrition intervention. However, in the

sitting posture, results of the nutrition intervention ($t = 1.305$, $df = 10$, and $p = 0.221$ (two-tailed)) were not significant indicating that sitting posture did not change.

Pre- and post-nutrition test results.

The nutrition intervention had an educational intervention of a fourth-grade USDA nutrition unit to learn the basics of healthy eating. Providing each group with an equal amount of educational intervention eliminated the possibility that one group improved based on a guest education intervention alone. Eleven of the 13 students in the nutrition intervention took both the pre- and post-nutrition tests. The range of percentile scores for the pre-test was from 14% to 62%, and the range of percentile scores for the post-test was from 38% to 86%. The range of percentile improvement was 5% to 58 %. All of the students who completed both the pre- and post-test improved their scores. The range of improvement was 1–12 correct answers (Table 4.10.), which is significant ($t_{20} = 7.457$, $p < 0.0005$).

Table 4.10 *Nutrition Pre- and Post-Test Results*

	Mean \pm SEM Nutrition Test
	Correct Responses (n)
Pre-Test	8.63 \pm 0.64 (11)
Post-Test	15.18 \pm 0.61 (11)

To address research question three, “To what extent do participants value posture and want to make a change?” and research question four, “To what extent does the intervention provide enough education for participants to change their postural alignment?” the following four classes of qualitative data were examined. Responses used were taken from the Student Post Surveys, Teacher Post Survey, Student Post-Open-Ended Questions, and the Teacher Post-Open-Ended Questions.

Postural intervention post-survey results.

In the post-survey, a five-point Likert scale was used to determine students’ views on in the Postural Intervention. Each of the five statements called for one of the following ratings: strongly agree, agree, neutral, disagree, and strongly disagree (Table 4.11.). In order to determine if there was a trend in responses, the results were divided into three categories: agree, neutral, and disagree. There were a total of 37 responses to the first four statements and 36 responses to the last, statement five.

Table 4.11. *Student Post-Survey Results*

Student Post-Survey Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The five days of 30 minutes of posture instruction was helpful.	4	17	12	1	3
2. The reminder messages like "sit tall" playing every 20 minutes was helpful.	1	12	13	5	6
3. This posture instruction made it easier to pay attention.	2	10	16	7	2
4. This posture instruction made it easier to complete tasks.	2	6	21	6	2
5. This posture instruction made it easier to sit strong.	5	13	11	6	1

The two responses that showed at least 50% agreement were: “The five days of 30 minutes of posture instruction was helpful” (56.76%) and “This posture instruction made it easier to sit strong” (50%) (Table 4.12.).

Table 4.12. *Summary of Student Post-Survey Results*

Student Post-Survey Statements	Agree	Neutral	Disagree
1. The five days of 30 minutes of posture instruction was helpful.	21	12	4
2. The reminder messages like "sit tall" playing every 20 minutes was helpful.	13	13	11
3. This posture instruction made it easier to pay attention.	12	16	9
4. This posture instruction made it easier to complete tasks.	8	21	8
5. This posture instruction made it easier to sit strong.	18	11	7

Calculating the Chi-squared test comparing student's actual responses to expected responses for each question determined that only question 1 ($X^2_8 = 11.729$, $p < 0.001$) and question 5 ($X^2_8 = 5.057$, $p < 0.025$) had significant different results from an equal distribution of responses in each of the three categories (Question 2: $X^2_8 = 0.2152$, $p < 0.70$; Question 3: $X^2_8 = 1.993$, $p < 0.20$; Question 4: $X^2_8 = 3.122$, $p < 0.10$).

Teacher post-survey.

Teachers' post-survey of the Postural Intervention showed similar results to the student survey. Each of the six statements called for one of the following ratings: strongly agree, agree, neutral, disagree, and strongly disagree (Table 4.13.). Dividing the results into three categories—agree, neutral, and disagree—determined if there was a trend in the

responses (Table 4.14.). One teacher did not respond to statement three; otherwise all other statements received responses.

Table 4.13. *Teacher Post-Survey Results*

Teacher Post-Survey Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The initial five days of 30 minutes of instruction was beneficial.	1	3			
2. The reminder messages like "sit tall" playing every 20 minutes was helpful.	1	3			
3. Filling out the pre- and post-Vanderbilt ADHD Diagnostic Teacher Rating Scale and the post-brief written summary of any noted changes on each student was helpful.		1	1	1	
4. This intervention made a positive impact on my students' ability to pay attention.			3	1	
5. This intervention made a positive impact on my students' ability to complete tasks.			3	1	
6. This intervention made a positive impact on my students' postural alignment.		2	2		
Totals	2	9	9	3	0

In general, the teachers found the initial five days of 30 minutes of instruction ($X_{10}^2 = 8.030$, $p < 0.005$) and the “sit tall” every 20 minutes ($X_{10}^2 = 8.030$, $p < 0.005$) beneficial. Questions 3 ($X_{10}^2 = 0.250$, $p < 0.70$), 4 ($X_{10}^2 = 3.468$, $p < 0.075$), 5 ($X_{10}^2 = 3.468$, $p < 0.075$), and 6 ($X_{10}^2 = 1.993$, $p < 0.20$) did not reveal significant diversions from an equal distribution of responses in each of the three categories.

Table 4.14. *Summary of Teacher Post-Survey Results*

Teacher Post-Survey Statements	Agree	Neutral	Disagree
1. The initial five days of 30 minutes of instruction was beneficial.	4	0	0
2. The reminder messages like "sit tall" playing every 20 minutes was helpful.	4	0	0
3. Filling out the pre- and post-Vanderbuilt ADHD Diagnostic Teacher Rating Scale and the post-brief written summary of any noted changes on each student was helpful. ¹	1	1	1
4. This intervention made a positive impact on my students' ability to pay attention.	0	3	1
5. This intervention made a positive impact on my students' ability to complete tasks.	0	3	1
6. This intervention made a positive impact on my students' postural alignment.	2	2	0

¹One teacher did not respond.

Qualitative data sets provided direct responses from teachers and students regarding the interventions and personal thoughts about being involved in the study.

Post-open-ended questions on the student survey.

At the end of the Post-study survey there were two open-ended questions for the students to comment on: “I really liked . . . because . . .” and “I didn’t like . . . because . . .” Students’ responses were overwhelmingly positive about the experience, with 28 out of 41 comments (68.29%) stating why the students liked the postural education and only 13 out of 41 comments (31.71%) about not liking postural education. Appendix T offers the full list of responses.

The student and teacher posture follow-up questions were identical, and the responses demonstrate a greater awareness of themselves and the world around them. Eight questions explored how students or teachers may have changed their viewpoints. The first question asked participants to consider the world around them. The second and fourth questions asked about self-awareness. Four questions asked students and teachers how they interact with different people and the environment. The final question is open-ended to elicit any additional concerns. General trends of each question are presented below.

Post-open-ended questions on the student and teacher surveys results.

“What have you noticed about other people’s posture?”

Nine students stated they did not think about posture, while 30 students started to look at people’s postural alignment and felt they had enough information to make a

determination if it was good or not. All of the teachers in the study noticed that most people exhibit poor posture.

“How have you changed your posture?”

This question explored student self-awareness. Twelve out of 37 students stated they had not made any changes, while 25 students stated they had been aware of their posture and made an effort to improve their posture when needed. Teachers once again agreed 100% that they had made an effort to change their own posture.

“What changes have you noticed in the way you interact with others?”

This question sought information on how the participants interact with the people and places around them. Ten students reported awareness of a change when interacting with others, while 24 reported no change in interaction style. One teacher was unsure of any change; one stated, “They had more eye contact”; and two made no changes in their behavior, although one reminded the students about posture more often.

“How has your ability to focus changed?”

The fourth question targeted self-awareness. Nineteen students felt their ability to focus had improved, compared to 17 who had not noticed any change in their ability to focus. Teachers’ responses varied from “better focus” and “less tired” to “unsure” and “no change”.

“How does your posture change when you are at home, school, or in the community?”

Thirteen students responded that their posture did not change at all, while 21 noted that their posture changed based on the environment. Three of the teachers reported that they

were working to improve their posture in multiple environments in addition to changing their posture as a role model for the students. One teacher did not respond to this question.

“What are your thoughts about your posture being affected by people or the environment?”

Five students reported they did not know. The largest group of students, 15, said they improved their posture based upon what they observed. Thirteen students suggested there were no effects whatsoever. One teacher chose not to respond to this question. The other responses included “social norms,” a “trend to accept poor posture,” and “posture being a personal responsibility that is affected when poor posture is observed.”

“If you change your posture when you want to remember what people are saying, what are the changes you make to help you pay attention?”

Three students did not know, 14 students did not change their posture, and 17 stated they found a way to either sit or stand taller. Three teachers reported: standing straighter, taking notes while sitting properly, and putting shoulders back and sitting erect. One teacher did not respond.

“Do you have any other thoughts on the posture lessons you would like to share?” Only four students responded with something specific. The majority, 25 students, stated “no” or “nothing.” Three of the four teachers had no response while one had five specific suggestions for improving the study. All the students’ and teachers’ responses are in Appendix U.

Students' daily response noted on the exit slips.

The final qualitative data set was the students' response to the daily activity. In coding the responses the following themes emerged: a desire to learn about the function of the spine and how it affects the rest of the body; an awareness of different spinal alignments/postures; a positive value for postural alignment (an aligned spine looks better); an awareness that there are long-range health benefits of an aligned spine (e.g. more energy, less joint pain, improved balance, brain function); and an awareness that an aligned spine can increase one's strength. A complete list of the students' responses can be reviewed in Appendix V.

Summary.

The results of the CPIS suggest that students and teachers valued good posture and made a concentrated effort to improve it. Throughout this Children's Postural Improvement Study, students and teachers adjusted their posture each time the researcher entered the classroom (personal observation). This feature suggests two things: social awareness might be one part of the solution to improve posture, and the multidimensional aspects of a human study may impact the results (Holden, 2001).

The initial research question, "To what extent does the postural intervention improve posture?" showed significant results in two-tailed T-Test for both standing posture ($p < 0.01$) and sitting posture ($p < 0.01$). The positive t values indicate that more students did improve their standing and sitting posture in postural intervention. Most of the students' time in school is spent sitting down, and students in the postural

intervention were making a concerted effort to sit on their sit bones. In the nutrition intervention, only the standing posture showed significant results ($t = 6.708$, $df = 10$, and $p < 0.01$ (two-tailed)). In the sitting posture, results of the nutrition intervention ($t = 1.305$, $df = 10$, and $p = 0.221$ (two-tailed)) were not significant indicating that sitting posture did not change. The nutrition intervention group did not have the extended audio and visual reminders about posture, but without additional classes in the nutrition intervention, it is impossible to determine if this could have had an effect.

The second research question, “To what extent does improved postural alignment improve attention?” had borderline results for sitting. The Tests of Model Effects indicate the sitting posture has a borderline significance for improved math fluency ($X^2_2 = 5.847$, $p = 0.054$, which is significant to the 94.6%), but not for ADHD teacher rating scales ($X^2_2 = 1.868$, $p = 0.393$). Results for standing posture was not significant on either ADHD teacher ratings ($X^2_2 = 1.531$, $p = 0.216$) or math fluency ($X^2_2 = 0.933$, $p = 0.627$).

However, what did emerge was that students and teachers desired to have and maintain better posture. The majority of participants found it was both easier to sit strong, and that the posture instruction was helpful and beneficial. Thereby, answering this research question, “To what extent do participants value posture and want to make a change?” affirmatively.

The qualitative data from the open-ended prompts showed that a majority of students (68.29%) liked the postural education, and the themes from the exit slips showed a desire to learn about the spine, health benefits of postural alignment, and a positive

long-range value for spinal health. To answer the final research question, “To what extent does the intervention provide enough education for participants to change their postural alignment?” by comparing the postural rating scores between the interventions. Both the sitting and standing postural ratings did not differ significantly; therefore, a more robust educational intervention is needed for there to be a significant postural alignment rating change in both standing and sitting in the postural intervention.

This CPIS addressed only some of the components of the causes of musculoskeletal decline that were reported in the literature review (chapter 2). However, there may be many more contributing factors to postural alignment, attention, and learning engagement in school-age children that are not yet identified. The next section describes the results of the CES for which the CPIS provided important guiding principles.

Classroom Environmental Study Introduction

Chapter 3 provided an overview of the mixed-methodological and ethnographical approach of this CES. Data from the CES can be further divided into two sections, one looking at the sketches of ergonomic options and classroom configurations of the three schools, and the second based on direct observations of the fourth-grade classrooms. The observations allowed data to be gathered on:

1. The amount and correlations of leaning, allowable standing up and movement of students during the observed time to classroom and/or school and learning activities.

2. The placement of feet during instructional activities.
3. The noted differences and similarities between full class movement and individual movement allowed in each classroom and school.

Sketches of ergonomic options and classroom configurations.

Eighteen classrooms had stools purchased for the teachers by the school and provided teachers with more than one seating option. Twenty-six classrooms had rocker chairs purchased with school funds. Teachers personally brought other alternative student seating options into the classrooms. Ten classrooms had some adult-sized padded reception chairs to be used for adults during class gatherings or group work activities. Seven classes had couches for student use. Four classes had child-sized padded chairs and couches. Five classrooms had large pillows. Five other classrooms had beanbags. One classroom had both beanbags and foam chairs for comfortable seating close to the floor. Four classrooms had saucer chairs for the reading area. Two classrooms in one school had a tall table with bar stools for students in one corner of the room, which also provided a standing option for students and another location for small group work. Additional seating options noted were a recliner (one classroom), a glider chair (one classroom), an office chair (one classroom), and an exercise ball (two classrooms). A majority of classrooms (50) had at least one additional seating option for students, as compared to 28 classrooms with only the standard-issue school furniture. Nineteen classrooms had alternative seating options provided by the teachers (Table 4.15.). Only eight or 10% of the classes had chair-size options for the students.

Table 4.15. *Ergonomic Options*

Grade	Classes	Alternative Seating	Multiple Alternatives	Standard Furniture	Group Work	
					Table Present	Gathering Area
K*	8	6	3	2	2	8
K*/1st	1			1	1	1
1st	8	5	3	3	6	7
2nd	8	7	3	1	2	6
3rd	8	6		2	3	3
4th	8	6	2	2	3	5
5th	7	4	1	3	2	2
5th/6th	1			1	1	
6th	7	3	2	4	5	2
Resource*	21	12	4	9	19	12
ELP*	1	1	1			1
Totals	78	50	19	28	39	47

Note. *K = Kindergarten, Resource = Special Education Service, ELP = Extended Learning Program

The most common working surfaces for students were shared tables, 51.3%, and individual desks, 38.5% (Table 4.16.). Seven classrooms, 9%, used a combination of individual desks and shared table space. One classroom, 1.2%, still used the connected desk and chair units. Four classrooms, 5%, had a tall standing desk or a large music stand for teacher use, except when students approached and shared the taller working space. Two classrooms, 2.5%, had small round tables with an attached bench loop similar to cafeteria seating; three classrooms, 3.8%, had study carrels for students who need a less

distractive work station. One classroom, 1.2%, had a low table so students could sit on the floor to work. Only 22 classrooms, 28%, had working surfaces that could be adjusted to meet the needs of individual students, whereas 56 classrooms, 72%, had surfaces at a uniform height that offered no adjustment.

Of the 78 classrooms sketched, 60% or 47 classrooms had a clearly defined gathering area for the entire class (Table 4.17.). Half of the classrooms had a group worktable for small group lessons with the teacher or a small group work area for students. The inclusion of a gathering area group worktables, or alternative seating options indicates the teacher allows student movement within the classroom and students are not solely sitting at their desk or table.

Kindergarten, first, and, second grades, and resource rooms used tables for their working surface more often, offering little in the way of individualized ergonomics, other than placing two students with similar height at each table. Third- through sixth-grade rooms used individual desks that could be adjusted and chairs that came in standard 12-, 14-, 16-, and 18-inch heights.

Only 36% of the classrooms had standard furniture, while the majority of classrooms, 64%, had alternative seating, and 38% of classrooms with alternative seating had multiple options. Teachers and administrators recognized the need for alternative seating options for student and the need for movement from one location to another.

Table 4.16. *Seating for Students*

Grade	Adjoining Desks and chairs	Individual Desks and Chairs	Tables and Chairs	Both Desks and Tables
K			8	
K/1st			1	
1st		2	6	
2nd		3	5	
3rd		6	1	1
4th		5	2	1
5th		5	2	
5th/6th		1		
6th		7		
Resource	1	1	14	5
ELP			1	
Totals	1	30	40	7

Note. *K = Kindergarten, Resource = Special Education Service, ELP =

Extended Learning Program

Examining options by school: School A, with a total of 27 classrooms, had 12 classrooms with individual desks, 10 classrooms with tables, and 5 classrooms with a combination of seating at individual desks and tables (Table 4.17.). School B, with a total of 27 classrooms, had 11 classrooms with individual desks, 14 classrooms with tables and 2 classrooms with a combination of seating at individual desks and tables. School C, with a total of 24 classrooms, had 7 classrooms with individual desks, 16 classrooms with tables, and 1 classroom with adjoining desk and chair units.

Table 4.17. *Seating by School*

School	Adjoining Desks and chairs	Individual Desks and Chairs	Tables and Chairs	Both Desks and Tables
A		12	10	5
B		11	14	2
C	1	7	16	
Totals	1	30	40	7

When comparing the schools' actual seating to expected seating the results were not significant ($X^2_6 = 10.232$, $p < 0.15$). The principal, who has authority for purchasing furniture, determines seating in each school.

Classroom sketches were coded two ways to examine movement and posture. Availability of movement is determined by the amount of open space available for students and the teacher to move. The number of desk clusters or table clusters in each classroom determined the amount of open space. Having fewer clusters provided more open space that teachers could use. Classrooms were divided into seven categories with 1, 2, 3, 4, 5, 6, and 7+ clusters of desks or tables. Examining posture, classrooms were coded by the relation of the students seating to the primary instructional tool (smart board, white board, or screen). Coding designations were facing, perpendicular, both facing and perpendicular, and a combination of directly behind, facing, and perpendicular toward the instructional delivery site. Tables 4.18. and 4.19. summarize the results.

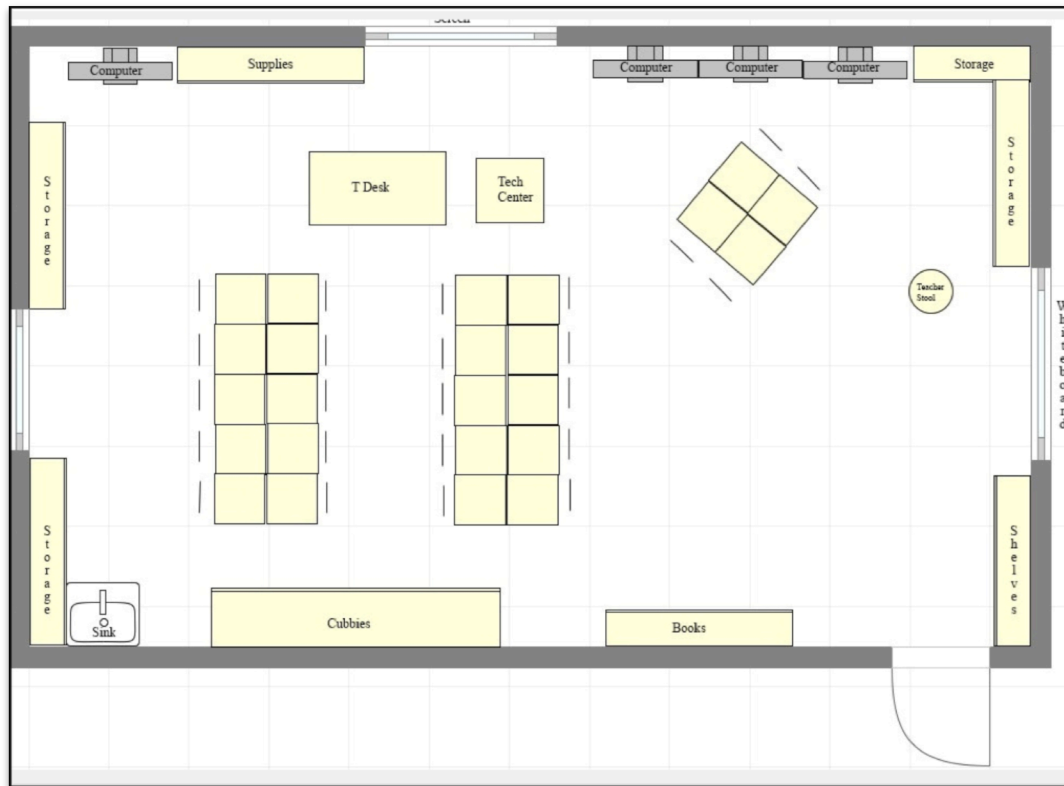


Figure 4.3. Sketch of Classroom B2

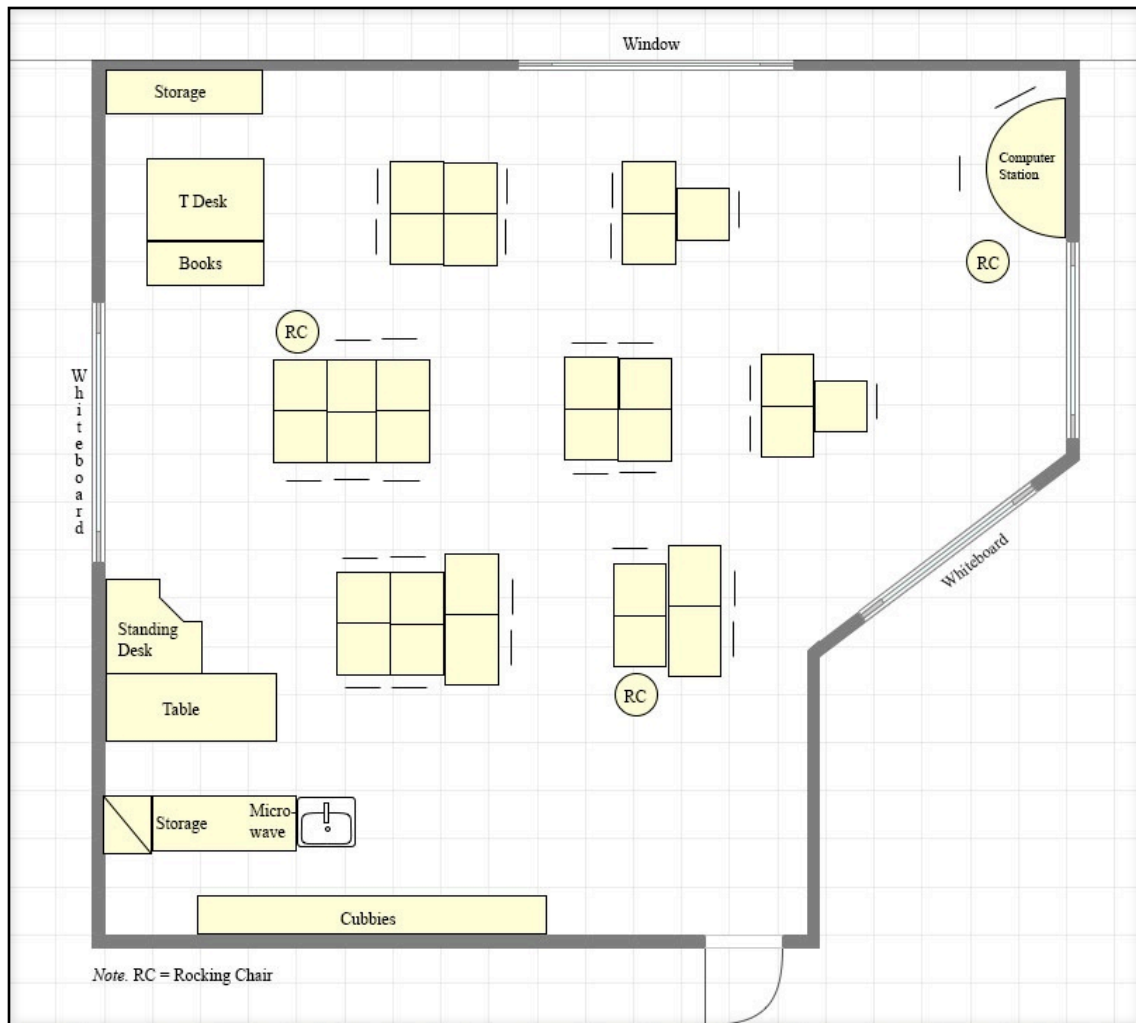


Figure 4.4. Sketch of Classroom A1

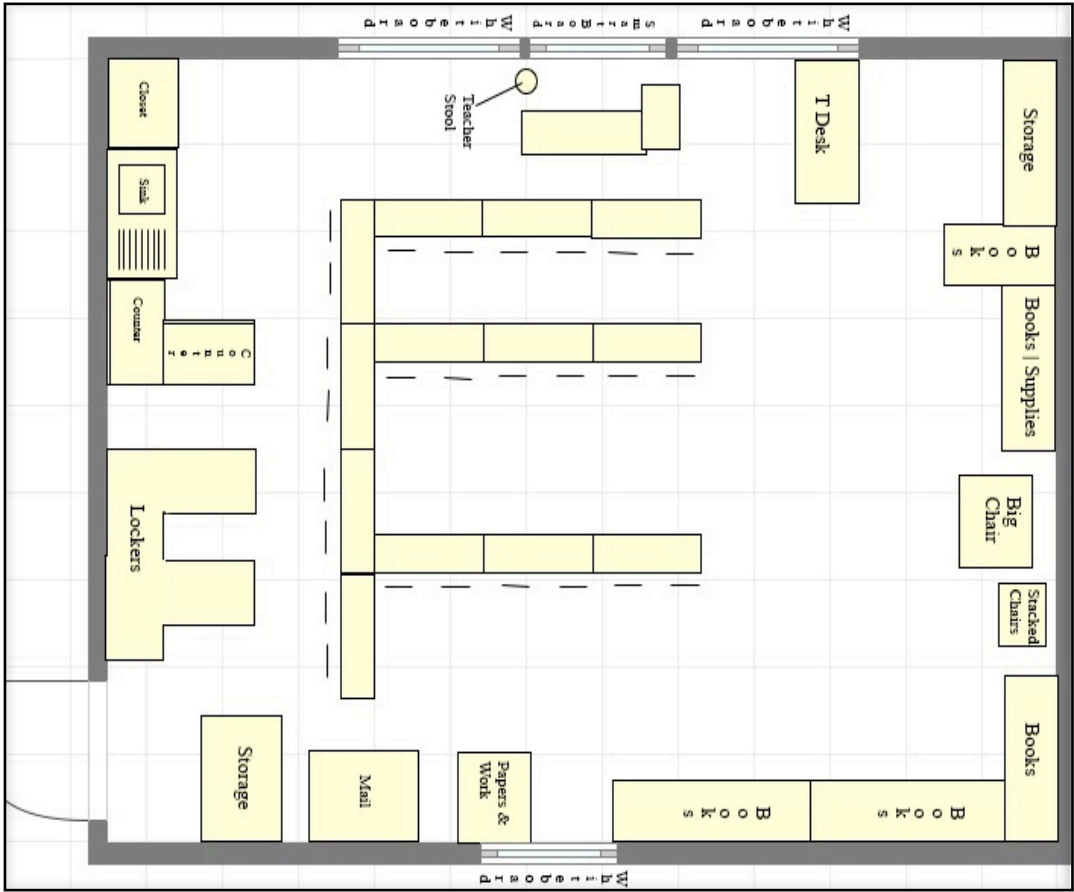


Figure 4.5. Sketch of Classroom C3

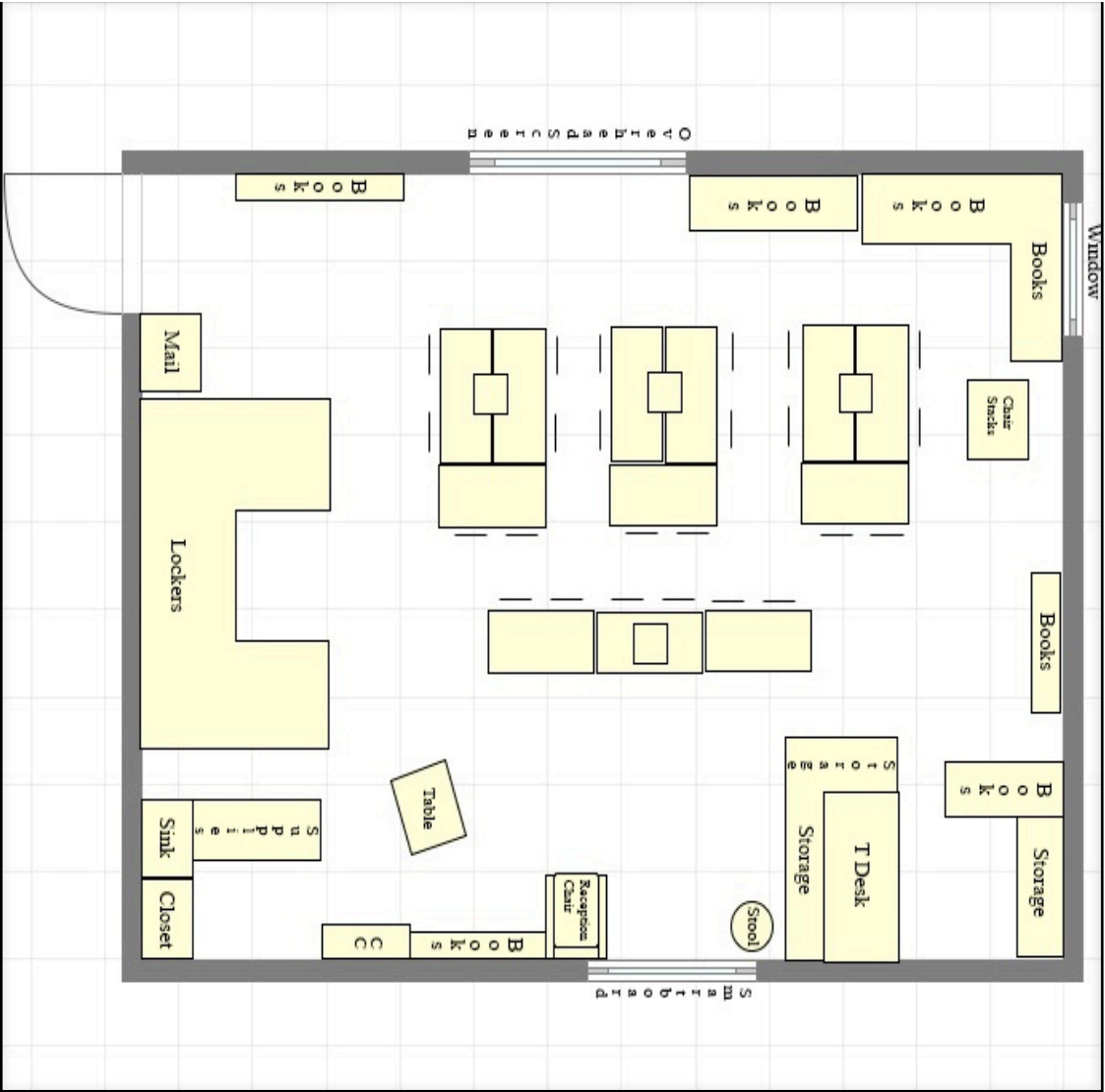


Figure 4.6. Sketch of Classroom C1

Table 4.18. *Desk and Table Clusters*

Grade	Desk and Table Clusters						
	1	2	3	4	5	6	7+
Kindergarten		3	2	1	2		
Kindergarten/1st				1			
1st			1	1	3	2	1
2nd		1	2	1	4		
3rd					1	5	2
4th	1		1	2		2	2
5th		1	1	2	1	1	1
5th/6th							1
6th		1	1	2	1	2	
Resource	9	6	3	1			2
ELP			1				
Totals	10	12	12	11	12	12	9

The calculated Chi-squared test compared the actual number of desk clusters by grade to the expected number of desk clusters by grade ($X_{60}^2 = 66.77$, $p < 0.3$) and was not significant. Next the calculated Chi-squared test compared the actual number of desk clusters by school to the expected number of desk clusters by school ($X_{12}^2 = 12.85$, $p < 0.4$) was not significant. Further observational data would need to be taken to determine if the number of desk clusters influence the amount of movement in the classroom.

Table 4.19 *Seating Relationship to Instruction Delivery*

Grade	Facing	Perpendicular	Combination of Facing, Directly Behind and Perpendicular	
			Both Facing and Perpendicular	Perpendicular
Kindergarten			3	5
Kindergarten/1st				1
1st		2	2	4
2nd	1	1	5	1
3rd	1	2	4	1
4th		1	7	
5th	1	2	4	
5th/6th				1
6th	1		5	1
Resource	14		6	1
ELP			1	
Totals	18	8	37	15

Another question emerged from the coding: Is there a preferred seating relationship to instructional delivery? At first, I considered how it affected posture; did students constantly turn to the right or the left or completely around? Observed students sometimes turned their whole bodies to face the instruction site and sometimes did not. There could be an entire new study just looking at this aspect of seating. Only 23.1% of the classrooms have students facing the instructional delivery site, and 78% of these are resource room locations where students get small group and individualized direct

instruction; 10.3% of the classrooms have students sitting perpendicularly to instructional delivery, requiring students to either keep their neck turned at a 90° angle or move their chair around; 47.4% of the classrooms have a combination of students either facing or perpendicular to it; and 19.2% of the classrooms have a combination of students either facing, directly behind, or perpendicular to it.

The calculated Chi-squared test compared the actual seating relationship to instructional delivery by grade to the expected number of seating relationship to instructional delivery by grade ($X_{30}^2 = 52.9$, $p < 0.01$) and was significant. The resource classrooms were mostly facing the instructional delivery, while the Kindergarten and the first grade classrooms were predominantly a combination of facing, perpendicular, and directly behind (Table 4.19.). The next calculated Chi-squared test compared the actual number of seating relationship to instructional delivery by school to the expected number of seating relationship to instructional delivery by school ($X_8^2 = 16.55$, $p < 0.05$) was also significant. School A did have multiple small and large group instructional rooms, which required students to face the teacher and the instructional delivery.

Fourth-grade observations.

Student leaning, allowable standing up, and movement correlations.

The observation data show general trends for leaning (occurred the least), standing up (intermediate occurrences), and movement (occurred the most). A two-way ANOVA was used to determine any classroom or school effect for each observed behavior (leaning, standing up and moving). The school effect for leaning was significant

($F_{2,16} = 9.96$, $p < 0.0016$). Leaning in School A (2.18 ± 0.33) was significantly ($p < 0.05$), higher than School B (0.59 ± 0.22) while school C had an intermediate value (1.32 ± 0.37). The classroom effect nested within School was significant ($F_{5,16} = 4.16$, $p < 0.013$). In School C, Classroom 2 significantly different from Classroom 1 and 3 ($p < 0.05$), while the classrooms did not differ significantly within Schools A and B (Fig. 4.7.).

The School effect for moving was not significant ($F_{2,16} = 0.00$, $p < 0.9996$). The classroom effect nested within School for moving was significant ($F_{5,16} = 2.99$, $p < 0.0429$). In School B Classrooms 1 and 3 were significantly different from each other ($p < 0.05$), while the classrooms did not differ significantly with Schools A and C (Fig. 4.7.).

The School effect for standing up was not significant ($F_{2,16} = 0.16$, $p < 0.8575$). The classroom effect nested within School was significant ($F_{5,16} = 2.88$, $p < 0.0486$). In School B, Classrooms 2 and 3 were significantly different from each other ($p < 0.05$), while the classrooms did not differ significantly within Schools A and C (Fig. 4.7.).

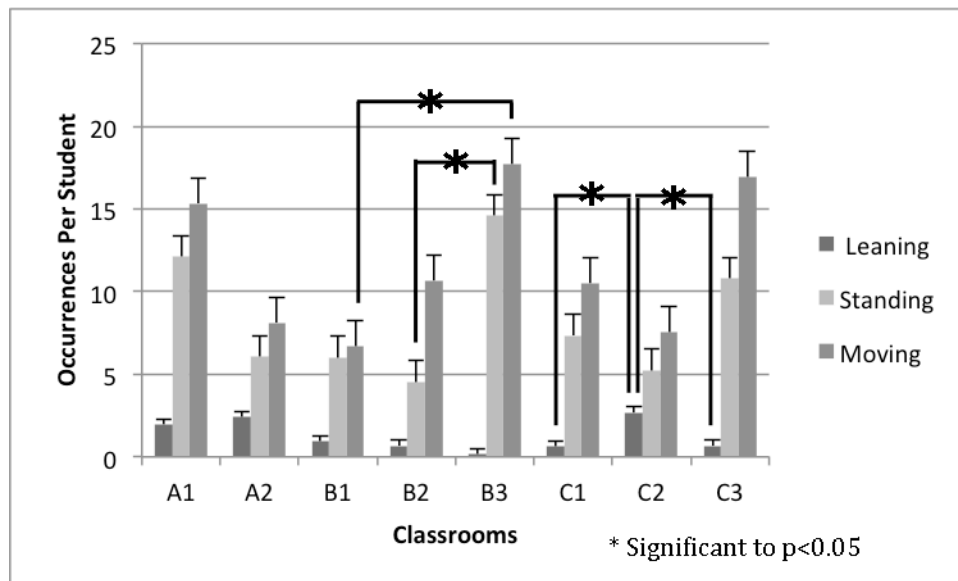


Figure 4.7. Mean (\pm SEM) Leaning, Standing and Moving Behaviors in Classrooms of Three Schools.

Linear correlations between standing up and moving, leaning and moving, and leaning and standing up were analyzed. The correlation between standing up and movement was significant ($r = 0.8643$, $p < 0.002$; Figure 4.8.). The correlations between leaning and moving ($r = 0.212$, $p < 0.2$; Figure 4.9.) and between leaning and standing ($r = 0.0632$, $p > 0.2$ Figure 4.10.) were not significant.

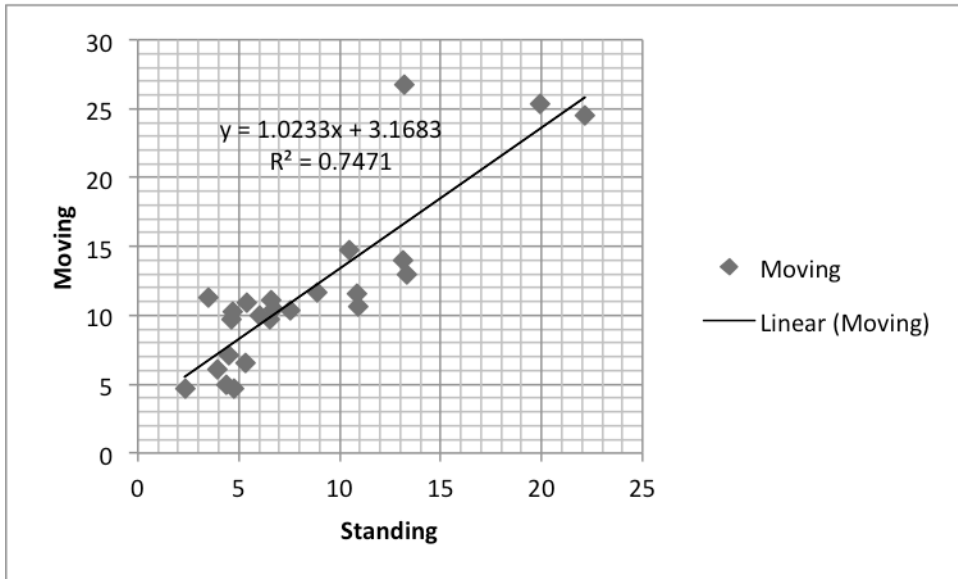


Figure 4.8. Standing Moving Correlation Bivariate Scatterplot

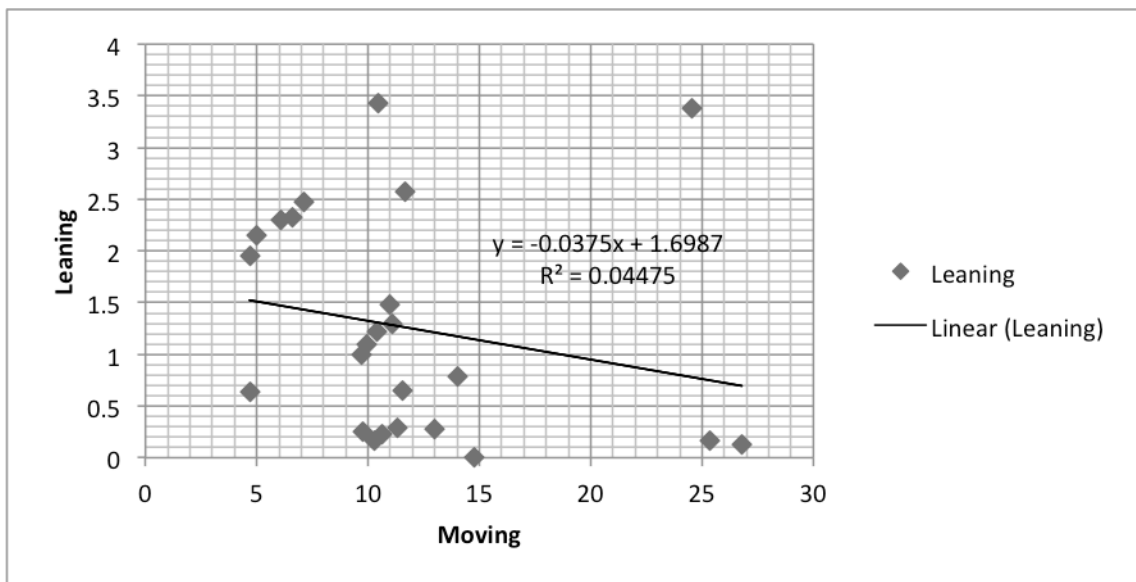


Figure 4.9. Leaning Moving Correlation Bivariate Scatterplot

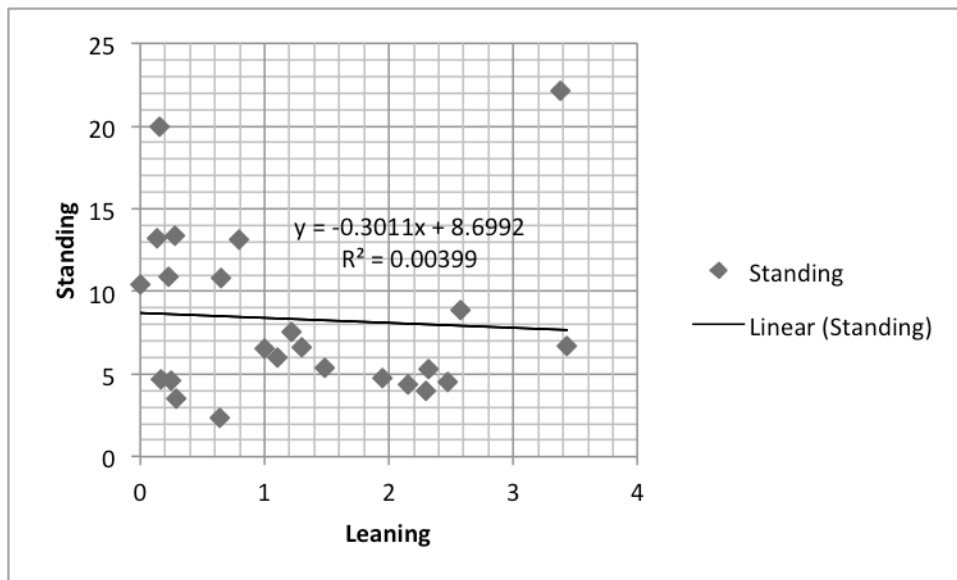


Figure 4.10. Leaning Standing Correlation Bivariate Scatterplot

After coding the classroom sketches, I examined the following null hypotheses:

1. Classroom clusters have no significant effect on leaning, standing, or movement in the classroom.
2. Seating relationship to instructional delivery has no significant effect on leaning, standing, or movement in the classroom.

Using multiple correlations to determine any underlying effect is a recognized practice with educational studies (Tanner, 2012). SPSS partial correlations and multivariate tests were used to analyze variables: leaning, standing, movement, seating relationship to instructional delivery (labeled Direction), and classroom clusters (labeled

Clusters) controlling for Cluster and then controlling for Direction retained the null hypothesis. All possible partial correlations (22) resulted with only one consistent significant correlation (two-tailed) between standing and movement to 0.001. No significance was found controlling for clusters or direction when looking at leaning, standing and movement. Multivariate results confirmed no significance results for clusters and movement (0.934), leaning (0.787), or standing (0.609), or direction and movement (0.847), leaning (0.670), or standing (0.481).

Field notes.

Each of the classrooms allowed teacher-directed full class movement (FCM). The type and extent of FCM is a reflection of the individual teacher as each determines the number and purpose of the movements. Time of day and the activities observed in each classroom are illustrated in Table 4.18. Additional classroom observations follow for each classroom setting. Overall trends are noted in the summary at the end of this chapter.

Table 4.20. *Classroom Observation Time and Activities*

	Obser vation 1	Activities	Obser vation 2	Activities	Obser vation 3	Activities
A 1	09/20/ 12 9:55 a.m.	Teacher lecture, mad minute, FCM spelling vocabulary word game	10/04/ 12 9:12 a.m.	Independent work, map quiz, FCM snack, mad minute, math	10/08/ 12 9:45 a.m.	FCM Snack, spelling test, pen pal letters, discussion for writing prompt
A 2	09/20/ 12 8:45 a.m.	Sustained Silent Reading (SSR), math: teacher lecture and FCM independent work	10/04/ 12 10:15 a.m.	Reading partners, FCM Oral reading – Play, journal writing	10/08/ 12 8:38 a.m.	Math: lesson, FCM game, and FCM independent work
B 1	09/19/ 12 12:24 p.m.	Writing, computer lesson	10/03/ 12 12:40 p.m.	Art lecture, FCM insect dance, art project	10/15/ 12 9:04 a.m.	Math: lecture, FCM independent work, teacher lesson
B 2	09/18/ 12 12:30 p.m.	Lunch clean-up, writing, FCM independent writing, FCM break	10/03/ 12 8:50 a.m.	Math, FCM practice math test, FCM break, back to practice math test	10/11/ 12 1:03 p.m.	Spelling test, FCM break, FCM to gathering area teacher instructions, FCM break, oral reading in gathering area
B 3	09/19/ 12 8:55 a.m.	Handwriting, Independent spelling work, writing	10/04/ 12 12:35 p.m.	Writing to pen pals, FCM to look at pen pal picture, Math lesson, FCM to get card, FCM quiz, quiz, trade activity	10/12/ 12 8:58 a.m.	Reading, vocabulary lesson, FCM partner work, FCM break and independent work spelling, AK map, KG buddies enter for reading
C 1	09/17/ 12 9:00 a.m.	Pick chairs, settle in with materials, math, FCM with chairs to gathering area, current events, DOL	10/01/ 12 10:15 a.m.	Class meeting in gathering area, FCM movement games, vocabulary, readers' theater	10/09/ 12 9:59 a.m.	Geography globe activity with partners, FCM class meeting in gathering area, FCM movement games, Teacher reads
C 2	09/18/ 12 9:15 a.m.	Class meeting in gathering area, FCM brain gym exercises, Teacher reads, FCM partner reading	10/01/ 12 9:07 a.m.	Class meeting in gathering area, FCM brain gym exercises, 2 FCM agendas, SSR, reading, writing	10/09/ 12 1:15 p.m.	Oral math, FCM math games, FCM return games, vote on new book, FCM to gathering area for class meeting
C 3	09/17/ 12 10:08 a.m.	Teacher reads in gathering area, 2 FCM to get white boards for math lesson, FCM behavior management	10/02/ 12 9:00 a.m.	Teacher greets each student, independent work, agenda, homework, SSR, mad minute, FCM to gathering area teacher reads, FCM partner reading	10/11/ 12 9:02 a.m.	Morning routine, attendance, lunch count, independent work, geography lesson, mad minute, geography trade to grade papers

Classroom A1 had a FCM during every observation. Two allowed all students to get up for a snack and included an average 10-minute break to walk around and socialize. The other FCM consisted of an instructional activity in which students visited 20 stations to answer worksheet questions. Out of the three measured behaviors, standing up and moving received the highest counts. However, during one observation period leaning occurred more than three times higher than standing up and moving due to a 25-minute science lecture in which students were passive listeners. It is interesting that during this science lecture, the two students who were assigned to rocker chairs kept the chairs in rocking motion for the duration of the lecture.

Classroom layout changed twice during the three observation periods. In this classroom, all the individual desks were adjusted to the same height—too tall for the majority of the students. The fluctuation of student population gleaned the following observations regarding desk heights. During the first observation, it was noted that 14 student desks were too tall; on the second observation, 10 student desks were too tall, and on the third observation 25 student desks were too tall. These desks were at the level of the student's armpits, causing their elbows to project to the side and shoulders to hunch up. When the teacher sat down, in contrast, his desk and chair allowed for a proper ergonomic working position with the elbow rested on the desk at a 90° angle. Perhaps the teacher did not have the proper awareness or recognition of the need for proper ergonomics for students.

During instructional time the teacher was in constant motion around the classroom causing students to track his movement. When the teacher was stationary, the

students chorally repeated back important directions or facts often using different accents, cadence, and speed. The teacher gave students transitional time warnings when activities changed.

Class A2 had only two FCMs, with both being for academic practice. The teacher directed specific student pairs to specific places throughout the classroom to practice with each other. This teacher was more stationary, primarily using a stool, tall music stand, and the document camera for instructional purposes. There was a constant change in student population; sometimes as many as 15 students (half the class) would leave the room, to come and go for special services. Students were allowed individual movement to get materials, snacks, and water, and to sharpen pencils, as long as no one was talking. The teacher asked students to return to their seats during instructional time.

Observations revealed that this classroom had approximately twice as many instances of leaning during instructional time. This finding could be related to the stationary position of the teacher. In addition, all desks were too tall for the students, causing their elbows to project to the side and their shoulders to hunch up. One student stood while working, and it was noted that this student had a comfortable 90°-elbow angle in this position.

Class B1 allowed only one FCM during all observation periods. This FCM was a demonstration of the insect dance led by the classroom teacher for the visiting art teacher. Students were allowed to move independently for snacks, water, and material needs. At the beginning of the year, during an open house and with parent support, students selected chairs based on height and ability to reach the floor with their feet while sitting.

However, there were only two static heights to choose from: smaller or larger. The desks were not adjusted for student height. Therefore, when students were sitting their elbows were below the desktop level. When the students needed to write, the elevation caused their shoulders to hunch up and their elbows to project out to the edges of the desks. It is interesting to note that two rocker chairs were assigned to students in this classroom. The two rocker chairs were in constant motion during all observations.

During one observation, students received laptops and during that work period, no leaning was observed. When laptops were closed for a lecture, student leaning behavior emerged. During the second observation in this classroom, artists were giving a background lecture before a hands-on creative activity. During the lecture 100% of the students were leaning. When the hands-on activity began, 0% of the students were leaning. During this observation period, it was interesting to note that four students worked at their desks in a standing position. When standing, these students could use their desks while maintaining ergonomically correct positions.

The final observation began with an instructional math lesson using a document camera. During the first 21 minutes, most students listened, four students sharpened their pencils, and one student got a coat. Many students were leaning during this lecture. At 22 minutes, four students stood up at the same time to move. The teacher directed them back to their seats and continued the lesson for an additional 8 minutes. During those 8 minutes, many students rested their heads and arms on the desktops. At the end of the lecture, students were instructed to work with partners anywhere in the room. Not all

students moved or chose a partner. These sedentary students did not understand the math concepts nor did they make an attempt to ask questions (not engaged in the learning).

Class B2 had seven FCMs, three designed as mental breaks for the students, three that allowed students to sit anywhere in the classroom to complete a short academic activity, and one to return to their desks. Students knew they would get periodic breaks for snacks water, and the restroom, so spontaneous individual out-of-seat movement was minimal. At the beginning of the year during an open house, the chairs were selected for the students, with parent support, based on height and ability to reach the floor with feet flat while sitting. However, there were only two static heights to choose from: higher or lower. Desks were all at a uniform height, which did not allow for individual differences. The one rocker chair in the classroom was rotated weekly among each group of desks. During that week, students decided who sat in it and for what period of time. Regardless of who was sitting in it, the rocker chair always rocked.

The teacher was in constant motion, whether giving instructions or lecturing, which required students to track the teacher's motion to stay engaged. The teacher intermittently gave prizes (e.g., stuffed animals, pillows, fidgets, etc.) to students who answered a question or displayed appropriate learning behaviors. The only time the teacher was in a stationary position was when reading to the students. During this activity, the teacher randomly called on students to read a line or two and then gave specific positive feedback to each one regarding the quality of their reading. This teacher provided short breaks (2–3 minutes) after each lesson or activity. For learning and break activities, a countdown timer was visible to the students on screen. Students respected the

timer and transitions were less than 20 seconds. During breaks, students all got up and moved around the classroom. They visited and looked at projects, got a snack or a sip of water, or went to the restroom. Leaning behaviors were considerably less in this classroom.

Class B3 had five FCMs and all were related to an academic task. This classroom had the highest rate of standing up and moving and the lowest rate of leaning. Individual students were in constant motion throughout each observation to attend to their needs, go up to the board to copy information projected there, or ask the teacher a question. This classroom also has the greatest number of seating options for the students: beanbags, foam chairs, reception chairs, a couch, and an office chair next to a study carrel. The teacher did not have a desk and just used an area behind a bookshelf for materials. The teacher occasionally rested on a stool but spent most time circulating in the classroom. The desk arrangement was changed three times during the observation period.

Desks and chairs were not sized to the students. Seven students could reach the floor with only their toes when sitting down and were often observed standing at their desk. Students were allowed to work anywhere in the room and often choose areas other than their desks.

Class C1 had seven FCMs, and all were related to team-building games and fun. They occurred at the end of the morning classroom meetings. Students clearly enjoyed the games and it provided a positive transition back to an academic activity. During all observations, students were back to their desks with their chairs in hand and ready to work in less than 20 seconds during all observations.

This class was unique in that there was no assigned seating. Every morning students would come in, get a chair from the stack and picked a place to sit. All the chairs and tables were the same size. There were two rocker chairs assigned to students, who were observed to rock nonstop. Students who sat next to the rocker chair tipped back on two chair legs mimicking the rocking movement.

Class C2 had seven FCMs, with three related to attending or returning from a class meeting when all students sat on the floor, two related to getting materials, one related to a group exercise led by the teacher involving students crossing their midline and deep breathing, and one related to working in small groups on a math game to reinforce skills. Individual class movement was allowed for getting materials or transitioning to special classes.

Surprisingly, 16 students could not reach the floor when sitting in their chairs. There were only four students tall enough to sit in their chairs with their feet flat on the floor. None of the desks allowed a 90° elbow angle. When students moved their elbows to the edge of the desk, their shoulders hunched up. Leaning in this classroom was the highest: 100% of students at desks were leaning during an activity that required their attention for an individual performance of one student.

In class C3 the teacher started each day shaking every student's hand and greeting them by name. They also greeted him by name before they enter the classroom. Class C3 had five FCMs; two involved moving back and forth from a gathering area for reading activity, one involved getting materials, one involved answering questions, and one was related to classroom management and getting everyone back on track. This classroom had

the second highest rate of movement. It was rare for all students to be sitting at the same time, except when listening to the teacher read a story. Students sat and lay on the floor in various positions and changed their positions frequently. During the third observation there were only 17 seconds during the hour when all students were seated simultaneously. Due to the ability of students to move at any time, in two observations there were only three instances of leaning. Leaning increased during one observation when students were doing silent reading.

Feet placement during instructional activity.

Students were constantly moving, even while in their seats. A variety of student feet placements occurred during instructional time. Feet dangled above the floor; were flatly grounded on the floor; or were positioned both in front of a chair rested on a heel or a toe or crossed at the ankles, both under the chair balanced on toes or crossed at the ankles, a split position with one foot in front and one foot in back, and finally on the chair tucked under the student's body. Students changed their feet positions multiple times during the observation. Students' feet were rarely flat on the floor. Those who had their feet on the floor were the only students who had a chair sized to their height correctly. Student feet position was often dictated by the size of the chair. Some students had to sit at the very edge of their chair or tip forward to touch the floor; if they sat back in their chair, they simply swung their feet since they couldn't reach the floor in that position. The necessary motion to keep them engaged in their learning was provided by changing feet positions.

Summary.

The purpose of this CES was to obtain basic baseline data of what is occurring in classrooms now; the average amount of leaning, allowable standing up, and the extent of student movement during an observational period, seating options for students, and configurations of the classrooms. The research questions were:

1. How much leaning, standing up and movement are allowed in the classroom during three 1-hour observations?
2. What ergonomic options are available to students?
3. To what extent does the classroom layout lend itself to student movement?

As with any mixed-method study additional questions came to the surface through the observations. Three additional questions were addressed in this study: What are the preferred feet placements during instructional activities and the rationale for the different placements? What are noted differences and similarities between full class movement and individual movement allowed in each classroom and school? Is there a preferred seating relationship to instructional delivery? Since this was a purely observational study with no intervention implemented, the researcher appeared in the classrooms at random times and there was no interaction with the participants, there was minimal change in behavior due to the researcher's presence compared with the CPIS, where the researcher provided educational interventions. The effect of the observation had minimal effect on the results, lending this study to be more significant. Changes in the environment of the classroom may have a more lasting impact than an educational intervention.

Feet placement and the constant movement of the feet demonstrate students' continuous need for movement to maintain a sense of alertness and ability to concentrate on the task at hand. Inaction of the physical body causes accumulation of waste products that causes fatigue (Todd, 1937); students' foot motions are warding off this effect. Individual and full classroom movements are also an anti-fatigue measure and were teacher allowed or directed. All the classrooms allowed individual movement during instructional time if the movements did not interrupt the instruction. All of the fourth-grade classroom teachers allowed full classroom movement during the observational time. One class in particular had students take a 2- to 3-minute break every 20–25 minutes. Because of the regularity of the breaks, students were very respectful about getting back to instructional activities.

Significance for seating relationship to instructional delivery was found significant between both grade level and school. One school in particular was designed with multiple small and large group rooms, which had students facing in instructional delivery for direct instruction. The most popular seating relationship to instruction delivery was a combination of facing and perpendicular to directions.

Many of the desks and all of the chairs provided did not allow for proper ergonomic positioning. In fact, the desks and chairs sometimes put students in harmful positions, with shoulders hunched up to their ears. Occupational therapists have noted problems related to student workstations. An unintended consequence for students who sit at workstations that are too tall is the development of a right-handed hook when writing in order to see what they are writing (P. Gannon, personal communication,

January 7, 2013). School-provided seating options (see Appendix R) consisted mostly of hard molded plastic chairs that came in proportional 12-, 14-, 16-, and 18-inch sizes. The seat had a concave dip, and a taller lip at the edge of the chair seat, and the chair back leaned back at 110°, causing further muscle strain (P. Gannon, personal communication, January 7, 2013). In 26 classrooms the school provided other options; a rocker chair, was designated, in most cases, to particular students who needed the sensory input of constant movement. Students who used the rocker chair, rarely, if ever, stopped moving. Other seating options, in limited numbers, were brought in by teachers and were well used by students. The majority of the work surfaces in the three schools consisted of shared tables (40 classrooms) that offered no individual adjustment or individual desks (30 classrooms). Fifty-six or 72% of the classrooms kept the students' workstations at a uniform height, and only 22 or 28% were individually adjusted. A district occupational therapist, noticed the increase in uniform desk heights when teachers began using more cooperative group activities (P. Gannon, personal communication, January 7, 2013). She offers student chair and desk fittings at the beginning of each semester depending on her caseload. Gannon reports that few teachers accept the offer. Custodians at all the schools, reported adjusting desks and table heights at the beginning of the year. Students often grow taller during the school year and would benefit from additional adjustments to desk and chair size. Ideally students would be taught how to size their own seating and would know when to ask for an adjustment. Several teachers reported they only adjusted desks when students requested it; some reported liking a uniform desk height.

In 60% of the classrooms (47), clearly defined gathering areas for the entire class were present. Thirty-nine or half of the classrooms had a specific worktable for small groups and instruction. These two configurations provided movement options for teacher-directed student movement from one setting to the other. Determining how often these options are used would take full-day observational data over time, and it would be an excellent topic for future studies.

Chapter 5 Discussion and Conclusion

Introduction

The completion of the CPIS was an essential learning experience as well as a first step in design and implementation of the CES. The CPIS was also crucial to understanding the requirements necessary to frame sound and replicable future research studies in the context of students' posture and learning engagement in the classroom. The completion of the CES provided insight into the power of ethnographic research in educational settings. The importance of reflection and the examination of the various individual parts in order to find common themes for future recommendations became apparent, and proved to be vital, for all parties involved in teacher preparation programs. This chapter will summarize the interpretation of the results; discuss limitations, assumptions, and design controls; and conclude with remarks about both the CPIS and the CES.

Children's Postural Improvement Study

Implications of the Children's Postural Improvement Study.

The rates of childhood obesity are climbing (one in three children is overweight or obese), and diabetes and related medical costs have increased dramatically in the last 30 years (White House Task Force on Childhood Obesity, 2010). Children who face these challenges are less likely to move, develop the necessary core strength, or have the ability to maintain healthy postural alignment, but they can reclaim their musculoskeletal

health through movement (Vernikos, 2011). Society's unawareness and acceptance of the "looking cool" slouch confounds the problem of children's awareness and desire to maintain correct postural alignment. However, when participants in this CPIS realized the long-term effects of poor posture they made a concentrated effort to change (G. Cardon, De Bourdeaudhuij, & De Clercq, 2001; G. Cardon et al., 2002; E. Geldhof, Cardon, De Bourdeaudhuij, & De Clercq, 2006). Students wanted to learn how to sit in correct postural alignment; in fact, the ninth-grade classroom increased the amount of auditory and visual reminders while they were in their classroom. When educated about the differences between alignment and misalignment, young adults encourage one another to improve (Loye et al., 2011).

In this Children's Postural Improvement Study, it was hypothesized that students who had better posture would be able to pay better attention in class. This hypothesis was a simplistic solution to a complex, multifaceted problem within the context of learning engagement as a multifaceted theory (Silver, 2011). J. Couch (personal communication, January 15, 2009, July 18, 2011) has written, "We have many students who start with the Balance program, but very few stay with it for more than a few months." This seemingly offhand remark should have garnered more attention as an insightful recognition of the complexity of the postural misalignment problem (Dolphens et al., 2011; E. Geldhof et al., 2007). However, quantitative analysis using a T-Test and the two independent variables of change in standing posture and change in sitting posture indicated there was improvement in posture in both standing and sitting for the postural intervention. Further

sitting posture did have a borderline effect on math fluency but not on ADHD teacher rating scales.

When you lack the awareness of the postural alignment problem, the ability and desire to correct it are powerful roadblocks (Méndez & Gómez-Conesa, 2001; Noda & Tanaka-Matsumi, 2009; Vidal et al., 2011). Implementing a program for students who may not necessarily want to change from what they deemed a “comfortable position” was a natural response to a researcher where a trusted relationship was not yet in place. However, when participants were educated about postural alignment, it became a personal goal that many concentrated on. Students reported being more aware of their posture and wanting to improve it, and after the intervention all of the teachers and most of the students felt they could determine whether a person’s posture was correctly aligned.

Examining the average of the three postural rating results of the interventions in the standing position revealed that both interventions improved their postural alignment. The majority of the students felt the postural education was helpful and made it easier to sit strong, and the teachers were in agreement that the initial five days of postural education and the reminder messages to “sit tall” were beneficial. These results support the positive impact of the postural education (G. Cardon et al., 2000; Dekel & Heyman, 2008; Tinning, 2001; Vidal et al., 2011). Raising the student’s awareness about back health reinforced their desire to improve their posture. One student with excellent posture in the ninth-grade group became a model for the others once they realized they had an example of spinal alignment in the class.

A majority of students stated they changed their posture in correlation with the environment they found themselves in. This finding reflects the social dynamic of posture (Girlshealth.gov, 2011; Reneman, Poels, Geertzen, & Dijkstra, 2006). Teachers reported working on their personal posture and stated a desire to provide a good role model for their students. This finding clearly demonstrates the value placed on posture from the teacher perspective. Many of the students mentioned they adjusted their personal postural alignment based on their observations of other people. This finding shows that these students had an awareness of, and were influenced by, the posture of others (Stellefson & Eddy, 2008).

Students exhibited a positive attitude daily about the postural education program. Strong themes that emerged included learning the functions of the spine and how it impacts the body, strength and long-range health (self-awareness), the fact that different people have different postures (world awareness), and that correct postural alignment is preferred (judgment). As previous studies have stated, children are interested in activities that improve their strength and postural alignment, but maintenance of the change is very difficult to sustain over time (G. M. Cardon et al., 2007; Dekel & Heyman, 2008; E. Geldhof et al., 2007; E. Geldhof, D. De Clercq, et al., 2007). Students in the CPIS clearly wanted to improve and maintain their posture.

Limitations, assumptions and design controls.

The local public school district would not allow for any research project that impacted teacher time, including the time needed to send out and collect IRB consent

forms for participation in research studies. Because of this barrier, the first CPIS was a sample of convenience and conducted in two private schools with mixed grade levels. The nutrition intervention was a single class and lack of replication compromised the statistical analysis as an alternative intervention and the results are, therefore, suspect. The study base lacked the diversity one would expect in a human study in Fairbanks, Alaska (Table 5.1). When conducting a human study, student, parent, and teacher participation as well as possible biases must be considered. Another consideration inherent in the private school environment includes the tuition factor; the extra expense may result in a limited number of students, as well as limited economic and ethnic diversity when compared to the Fairbanks community in particular and when compared to the state of Alaska as a whole (Table 5.1.). Using the Chi-squared analysis, the population did differ significantly from both Fairbanks ($\chi^2 = 19.52$, $p < 0.01$) and Alaska ($\chi^2 = 15.38$, $p < 0.05$) with a bias towards white persons in the study groups.

Table 5.1. *Children's Postural Improvement Study Ethnicity Comparison*

	Study		
	Populations	Fairbanks	State of Alaska
White persons	82.5% (47)	62% (34)	64.0% (35)
African American persons	7.5% (3)	7.11% (4)	3.25% (2)
American Indian and Alaskan Native persons	2.5% (1)	8.90% (5)	17.39% (9)
Asian persons	2.5% (1)	4.57% (2)	5.06% (3)
Native Hawaiian and Other Pacific Islander persons	0.0% (0)	0.66% (0)	.73% (0)
Persons reporting two or more races	0.0% (0)	7.79% (4)	3.42% (20)
Persons of Hispanic or Latino origin	5.0% (2)	8.97% (5)	6.15% (3)
Total	100% (54)	100% (54)	100% (54)

Note. (US Census Bureau, 2010)

The intervention instruction was limited to 30 minutes/day for 5 days. The pre- and post-intervention pictures of the students record only a moment in time; the body is in constant motion. The pre- and post-intervention pictures should have been taken under identical situations with a script to read to the participants. The students knew what to expect with the math fluency post-intervention test and as a result may have had improved performance. Return rates of the parent pre- and post-intervention surveys were too low to use. Consistency in placement of posters and the visual and verbal reminders

was limited by classroom arrangement and teacher preference. Scheduling conflicts between the post-surveys and end of the semester activities did occur. Determining, via photographs and a moment in time, whether a person had and continues to have good posture or not is a subjective rating. Attention to detail and pre-planning with the school personnel is essential for future studies.

Conclusion.

Participant awareness of the benefits of proper external and internal postural alignment were realized through the Children's Postural Improvement Study. Both students and teachers stated a desire for improved posture and recognized and valued a new feeling of strength when their bodies were in proper spinal alignment. Teachers' varying degrees of buy-in was illustrated by one classroom increasing the number of reminder messages during class at the request of the students. Significant and important outcomes achieved during the short duration of this Children's Postural Improvement Study, should encourage future studies to improve postural alignment in young schoolchildren.

To what extent due to the intervention or something specific about the intervention was the cause of the change is difficult to determine. The "Hawthorne Effect" was coined to describe the effect of a series of experiments done between 1927 and 1933 in a Western Electric Company in Chicago by a Harvard researcher, Roethlisberger and a company manager, Dickson (Chiesa & Hobbs, 2008). Results of these experiments hypothesized that any change deemed to improve worker condition

(physical environment) would improve worker productivity and that people will behave differently if they know they are being observed (social interaction) (Harris, 2002).

Similar to these results, participants in the CPIS study did change their posture when I entered the classrooms. Positive change could be attributed to my positive expectations (Pygmalion effect) versus the negative attitude (Golem effect) of one teacher who reported not liking to stick one's bottom out to align their spine. Both the Pygmalion and the Golem effect have a substantiated effect on student behavior (Reynolds, 2007). One must also consider that change occurred due to an unexpected event, perhaps a grandmother who values posture came for a visit (Chiesa & Hobbs, 2008). Comments on exit slips and post-surveys indicate that the majority of participants had an interest in improving their posture based on the educational information presented during the intervention.

Eight out of nine studies indicated a positive association between classroom physical activities and academic performance (Centers for Disease Control and Prevention, 2010). In the current fiscally challenged and assessment-based educational system, many schools are cutting recess periods and cannot afford new classroom furniture, both of which negatively impact student physical activity and correct postural alignment. The National Institute of Health has funded a study, "Development of a stand-biased school desk to reduce childhood obesity," which will be completed in September 2013. This is one of the first U.S. school studies to explore ergonomic options for improved health (Wilke & Colley-Gilbert, 2011). Allowing students more ergonomic

options while learning is a positive step in educating students on their own body and what they can do to make it more efficient and healthy.

A follow-up CES to explore the learning environment and factors related to good postural alignment is discussed in the following section.

Classroom Environmental Study

Implications of the Classroom Environmental Study results.

The primary findings of this study are these: There is an ergonomic mismatch between classroom furniture and children; movement within each classroom is directed by the teacher's pedagogical style; and dynamic seating and the ability to move may improve learning engagement. Therapists have noted that the visible effects of ergonomic mismatches are unintended findings (P. Gannon, personal communication, January 7, 2013).

Ergonomic considerations for students (correctly sized chair and desk) are not a systematic concern in the schools observed. A body of literature ties adult back pain to pain during the school years and finds that students are experiencing pain from poor ergonomic seating and prolonged static positions (Boćkowski et al., 2007; Brattberg, 2004; Brink et al., 2009; Brower & Nash, 1979). Most classrooms used tables as workstations, which did not provide individualized and sized seating. Only one classroom had adjoining desks and chairs that offered no adjustment for height, which suggests that it could be a district trend to discontinue the purchase of these types of attached units for students. Two teachers mentioned that each student who attends the school's open house

would receive a chair, selected from two standard options that would allow them to reach or get their feet close to the floor. Teachers also stated it was helpful to have the parents involved with the chair selection process. It was not clear if the teachers later provided the same option for students who could not make it to the evening event. However, these same teachers all had student desks of uniform height, which indicates that awareness of ergonomic principles is limited in the settings observed. Findings have determined that ergonomics and school furniture adjusted to the person's size is vital to continued back health (Bennett & Tien, 2003; Milanese & Grimmer, 2004; Thompson, 2006).

The quantitative data showed there was more student movement in the classroom than expected from personal elementary teaching experience in the 1980s. Six of the eight teachers incorporated full class movement (FCM) breaks as part of a regular routine (Breithecker, 2011). The other two classrooms did have FCM breaks related to academic tasks that allowed students to move about the room, which research encourages and supports (G. Cardon et al., 2004; E. Jensen, 2005). It was not clear whether those breaks happened regularly. Surprisingly, teachers allowed quite a bit of individual movement during instructional time as long as it was respectful and did not negatively impact other students or activities. For example, students were allowed to sharpen pencils as needed. However, during the 24 hours of observations, students never sharpened pencils while either a student or a teacher was talking. Students waited for an opportune time or borrowed a sharpened pencil.

Effects of behaviors (leaning, standing up, and moving) in each of the classrooms are examined in this section. There was one school effect for leaning, but leaning was

relatively uncommon when compared to standing up and moving. The classroom effect nested with the school was significant for leaning, standing up, and moving. The only individual factor attributable to these results is the teacher (H. Gardner, 2011).

After coding the classroom sketches for number of clusters it was hypothesized that having fewer clusters allowed for greater movement within the classroom. Partial correlations of the observed classrooms' leaning, standing, movement, and direction compared to the number of clusters did not confirm the hypothesis. Since the observations were only an hour in length, this could be a topic for further study.

Once again the individual differences can be attributed to individual teachers and their pedagogical style: being more comfortable with teacher-directed learning versus student-directed learning; preferring a seat based learning versus an active classroom; and implementing their particular classroom management system.

Correlation between observed behaviors was limited. Standing up was correlated with movement because one generally must stand up prior to moving to a new location. Neither leaning and moving nor leaning and standing up revealed any significant correlation. This may be related to leaning being the least observed behavior and moving being the most prevalent. Higher leaning rates were observed during listening instructional time, individual student performance activities, and silent reading versus instructional activities involving high-stakes (quiz or test), hands-on partner or group work, or using some kind of instructional manipulative. Less leaning occurred in classes that allowed regular movement.

When seating was expected of students their body movements (leaning, wiggling, feet positioning) were observed. Breithecker (2008) suggests if students have access to dynamic seating and could move, like the students observed rocking in the rocker chairs, they can stay engaged in their learning. The tracking of the multiple foot positions used by the students demonstrated that the constant motion of students while sitting could support the need for more dynamic seating options for all students. The tracking also documented the positions some students needed to use in order to reach the floor, or have a foot in contact with something, by sitting at the edge of the chair and tipping it forward on two legs, by standing, or by moving to the floor or perching on top of the chair. These positions would not be suitable for the adult workplace and underscore the fact that students' ergonomic needs are not being met.

The state of school furniture and the negative impact of poorly designed furniture on students can be remedied with incorporating the positive benefits of correctly adjusted ergonomic seating (Breithecker, 2008; Brewer et al., 2009; Dhara et al., 2009). Students in both the CPIS and CES had limited choice of seating. Students were observed standing at their workstation, moving to the floor to work, and leaning and rocking their chairs when required to be in their seats. Students with poor ergonomic options did have freedom to change positions and stations throughout the day, which may reduce the effects of sitting for a prolonged time in an uncomfortable seat.

The relatively high level of movement in the classroom is encouraging, because studies have shown that students who engage in physical activity perform better academically (Almarode & Almarode, 2008; H. Gardner, 2011). Movement provided for

activating brain connections, team building, and taking care of self-needs is beneficial to learning engagement (E. Jensen, 2005; Sousa, 2009; Templeton & Jensen, 1996). Room arrangement that frees up an open area for classroom activities encourages teachers to teach in different locations, provides full class movement, and should be considered when teachers set up their classrooms.

Limitations, assumptions, and design controls.

As with all ethnographic research, the observations are a moment in time for a limited period (Colasacco, 2010; Good, 1988). The students rotated in and out of their main classroom for special activities and additional instruction throughout the day. Hence, the entire class was never in the room at the same time. Only three schools and one grade level were observed. Minimal information from teachers or students was gathered, as this study was purely observational. There was no time to talk with teachers regarding the importance and impact of movement as part of a daily routine. The following assumptions could only be partially met due to communication problems and the sheer volume of activities in some of the classrooms.

- All teachers would be notified of the ongoing research (one teacher requested a weekend prior to sketching their classroom configuration).
- Every behavior in the fourth-grades classes would be tracked during the 1-hour observation period; with only one observer this could not be guaranteed.

Some students exhibit high behavior occurrences, which can skew the data. School and classroom activities such as school pictures, nurse health checks, late buses, preparation for special field trips, peer buddy activities, and art or technology teacher visits can affect both teacher and student behavior and observational sessions.

Conclusion.

There was much more movement in the observed classrooms than expected, both FCM and individual movement (allowed as needed). Teachers' instructional methods controlled the amount of movement in their classroom based on their management styles. Both student and teacher movement decreased leaning behaviors. Students took every opportunity to move, as demonstrated by the students using rocker chairs who rocked continuously. An occupational therapist at School C stated occupational problems arise when students are static for extended periods (P. Gannon, personal communication, January 7, 2013). More leaning occurred when the teacher lectured or when individual students had to perform a task in front of the class. Little or no leaning occurred when students were involved in a hands-on activity or high-stakes activity (quiz or mad minute).

Principals and superintendents in the schools advised that seating is based on cost, and purchases are constrained by limited budgets. Often, classroom sets of furniture are bought at the end of the year with funds that cannot be carried over into the next fiscal year. The cost of future health care costs, in the billions, are never considered when purchasing school furniture even though studies have found a correlation between adult

back pain and back pain in school-age children (Boćkowski et al., 2007; Davis & Williams, 2008; Murphy et al., 2007; Salminen et al., 1999). School furniture designers should be able to provide economically feasible options that provide ergonomic adjustment for students and can be stacked.

Federal Occupational Safety and Health Administration standards would not allow the workstation conditions observed in the classroom to exist in the workplace, yet the vulnerable students have no similar standard to protect them (Aagaard & Storr-Paulsen, 1995; Knight & Noyes, 1999; Schultz, 2003; Thompson, 2006). The Fairbanks Borough ergonomist in a personal interview made it clear that she can do ergonomic evaluations for teachers (borough employees) but not for students (G. Murray, personal communication, November 15, 2012). With parental consent, teachers can request occupational therapy or a physical therapy evaluation for a student if they are unable to function in school with the limited seating choices. Some specialized chairs are available for students who experience a disability, but none is available to students who do not qualify for special services. In this study, two teachers commented on chair size, but neither teacher addressed the height of the desks, a major component of the student's workstation. Qualitative research themes validate that student-seating options are based on cost versus ergonomics.

Pre-service teachers should be educated not only on the basic concepts of ergonomics, but also on the physiological reasons behind having an appropriate workstation (Mandal, 2011; McNaught, 2001; Mokdad & Al-Ansari, 2009). Occasionally teachers were in their classrooms while I sketched and were willing to discuss the

rationale behind their classroom layout. On three occasions teachers reported they just kept the desks the same height unless there was a really tall student who complained that it was uncomfortable. Then and only then would they contact the custodian to make the necessary adjustment. Students who sat at desks or tables that were too tall or in chairs that didn't allow students to reach the floor were usually ignored. Five primary teachers reported that kids were flexible and personally adjusted stations were not necessary, especially when they do not spend that much time at their chairs. Incorporating information regarding body mechanics into a teacher education program could have a future impact on student seating and would be an interesting follow-up Classroom Environmental project.

Although this study was limited to observations, there are some recommendations that would help both student posture and learning engagement that have also been explored in other studies. Future studies could examine how these following recommendations would alter student engagement.

The most basic recommendation is to have adjustable chairs, desks, and tables allowing students to have their feet on the floor and arms resting comfortable on their desks in a 90° angle. Observed students had many ergonomic challenges, ranging from their inability to reach the floor with flat feet to having desks as tall as a seated student's armpits. Raising awareness of and teaching pre-service and current teachers about ergonomic health concepts and how to teach them to students would inform students on best practices for their own health. Chung and Wong's (2007) study confirms ergonomic

mismatch for students and supports the importance of adjusting current students' chairs and desks to meet their ergonomic needs.

The second recommendation is to inform pre-service teachers about the importance of movement and learning breaks. Sedentary activities, such as listening or completing an assignment, lasting longer than 20 minutes created a flurry of "must do" out-of-seat behaviors in the observed classrooms. The concept of a defined time for instruction by setting a timer for the work and break schedule was observed in this study and is supported by Jensen (2005). By creating an urgency to complete tasks and providing the processing time through movement the brain has time to cement connections to past knowledge (E. Jensen, 2005).

Human bodies are in constant motion adjusting to and evaluating the environment for danger; being still is unnatural. The observed subtle movement of students while tracking the teacher's movement was present in several classrooms and effective in keeping the student engaged and having them pay attention. Vernikos (2011) explains that getting up-and-down several times during the day is better than standing for an extended time. It is the up and down motion against gravity that tones the musculoskeletal system. Educating teachers and pre-service teachers to include movement pedagogy in their classroom while instructing is supported (Almarode & Almarode, 2008; Sousa, 2009; Templeton & Jensen, 1996). Schools of Education need to model these practices in their own classes so pre-service teachers experience the positive effects of movement for themselves. Internalizing the practice helps a teacher become a practitioner of movement.

Recommendations for Schools of Education and School Districts

Even though Gardner's theories of multiple intelligences and learning styles have been around for many years, not all classrooms have embraced mobile student-centered pedagogy (H. Gardner & Hatch, 1990). Pre-service teachers feel more in control of classrooms when students are seated, but they are unaware of the physiological implications of this practice. A section on body mechanics would be a helpful addition to the teacher education program (Dekel & Heyman, 2008). Based on the results of the CPIS instruction on spinal health would be welcome in the classroom (G. M. Cardon et al., 2007; E. Geldhof, G. Cardon, et al., 2007). Future research could look at how student assess a new classroom based on body mechanics and how they would make seating more ergonomically correct. Research could also include how the instruction of body mechanics by the pre-service teacher to their students influences their choices. Further research could look at the effects of proper ergonomic seating and classroom arrangement on student achievement.

A parent night to teach parents about body mechanics may encourage fund raising to build more ergonomic furniture or volunteers to adjust desk and chair heights for individual students. Parent involvement in any aspect of student learning encourages students to be engaged in their own learning (Henderson & Berla, 1994).

Dissemination

Complete analysis of the research as well as the recommendations will be shared with school principals at the private and public schools as well as with the local school district's research, special education, and administrative departments. Recommendations to Schools of Education include having more human mechanics and ergonomic principles in teacher preparation programs, as well as arranging classrooms to encourage student mobility. Articles will be submitted for publication in educational and ergonomic journals. Proposals for national educational conferences will be submitted. This document will be published and available.

References

- 1keydata.com (Producer). (2013, 03/20/13). List of 50 States. Retrieved from <http://state.1keydata.com/states-by-size.php>
- Aagaard, J., & Storr-Paulsen, A. (1995). A comparative study of three different kinds of school furniture. *Ergonomics*, 38(5), 1025-1035.
- ABC News. (2011). ABC Jamie Oliver's Food Revolution Retrieved 08/21/11, from <http://abc.go.com/shows/jamie-olivers-food-revolution>
- Alaska, S. o. (2010). HealthierUS School Challenge Retrieved 10/12/13, from <http://www.eed.state.ak.us/tls/cnp/healthier.html>
- Almarode, J., & Almarode, D. (2008). Energizing students. *Science Teacher*, 75(9), 32-35.
- Amato-Zech, N. A., Hoff, K. E., & Doepke, K. J. (2006). Increasing on-task behavior in the classroom: Extension of self-monitoring strategies. *Psychology in the Schools*, 43(2), 211-221. doi: 10.1002/pits.20137
- American Academy of Orthopaedic Surgeons. (2008). *The Burden of Musculoskeletal Diseases in the United States*. The Burden of Musculoskeletal Diseases in the United States | Home Retrieved from <http://www.boneandjointburden.org>.
- Arms, D., Burns, D., Kimmel, P., Newton-Ward, M., Pirani, S., & Watson, D. (1997). The Basics of Social Marketing Retrieved 10/15/2011, from <http://www.turningpointprogram.org/>
- Balagué, F., Dudler, J., & Nordin, M. (2003). Low-back pain in children. *Lancet*, 361(9367), 1403.
- Baumberger, B., Isableu, B., & Flückiger, M. (2004). The visual control of stability in children and adults: Postural readjustments in a ground optical flow. *Experimental Brain Research*, 159(1), 33-46.
- Beesley, A., Clark, T., Barker, J., Germeroth, C., Apthorp, H., Mid-continent Research for, E., & Learning. (2010). *Expeditionary learning schools: Theory of action and literature review of motivation, character, and engagement: Mid-continent Research for Education and Learning (McREL)*.
- Behar, M. (2006). Yoga therapy for Autistic children. *Yoga Therapy in Practice*, 2(2), 18-19.
- Bell, J. D., & Thatcher, D. (2012). Challenged to the core. *State Legislatures*, 38(8), 13-17.
- Bell, L. M., Curran, J. A., Byrne, S., Roby, H., Suriano, K., Jones, T. W., & Davis, E. A. (2011). High incidence of obesity co-morbidities in young children: A cross-sectional study. *Journal of Paediatrics and Child Health*, 47(12), 911-917. doi: 10.1111/j.1440-1754.2011.02102.x
- Bennett, C., & Tien, D. (2003, August). *Ergonomics for children and educational environments - around the world* Paper presented at the XVth Triennial Congress of the International Ergonomics Association, Seoul, Korea.

- Boćkowski, L., Sobaniec, W., Kułak, W., Smigielska-Kuzia, J., Sendrowski, K., & Roszkowska, M. (2007). Low back pain in school-age children: Risk factors, clinical features and diagnostic management. *Advances in Medical Sciences*, 52 Suppl 1, 221-223.
- Bond, M. (2007). *The new rules of posture: How to sit, stand, and move in the modern world*. Rochester, VT: Healing Arts Press.
- Brackley, H. M., Stevenson, J. M., & Selinger, J. C. (2009). Effect of backpack load placement on posture and spinal curvature in prepubescent children. *Work*, 32(3), 351-360. doi: 10.3233/wor-2009-0833
- Brattberg, G. (2004). Do pain problems in young school children persist into early adulthood? A 13-year follow-up. *European Journal of Pain (London, England)*, 8(3), 187-199.
- Breithecker, D. (2008). Charter school furniture supports students' learning. *School Planning & Management*, 47(10), 56-56.
- Breithecker, D. (2011). Beware the sitting trap. *Design Share: Designing for the future of learning*. Retrieved from DesignShare website: <http://www.designshare.com/index.php/articles/sitting-trap>
- Brewer, M., Davis, K. G., Dunning, K. K., & Succop, P. A. (2009). Does ergonomic mismatch at school impact pain in school children? *Work*, 34(4), 455-464. doi: 10.3233/wor-2009-0946
- Briggs, A. M., Straker, L. M., & Wark, J. D. (2009). Bone health and back pain: What do we know and where should we go? *Osteoporosis international*, 20(2), 209-219. doi: 10.1007/s00198-008-0719-7
- Brink, Y., Crous, L. C., Louw, Q. A., Grimmer-Somers, K., & Schreve, K. (2009). The association between postural alignment and psychosocial factors to upper quadrant pain in high school students: A prospective study. *Manual Therapy*, 14(6), 647-653.
- Briñol, P., Petty, R. E., & Wagner, B. (2009). Body posture effects on self-evaluation: A self-validation approach. *European Journal of Social Psychology*, 39(6), 1053-1064. doi: 10.1002/ejsp.607
- Brower, E. W., & Nash, C. L. (1979). Evaluating growth and posture in school-age children. *Nursing*, 9(4).
- Buderath, P., Gärtner, K., Frings, M., Christiansen, H., Schoch, B., Konczak, J., . . . Timmann, D. (2009). Postural and gait performance in children with attention deficit/hyperactivity disorder. *Gait and Posture*, 29(2), 249-254.
- Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, 56, 81-105.
- Canoy, D., & Buchan, I. (2007). Challenges in obesity epidemiology (Vol. 8, pp. 1-11): Correspondence address, I. Buchan, NIBHI, Med. Sch., Univ. of Manchester, Manchester M13 9PT, UK. E-mail: buchan@manchester.ac.uk.
- Cardon, G., & Balagué, F. (2004). Low back pain prevention's effects in schoolchildren. What is the evidence? *European Spine Journal*, 13(8), 663-679. doi: 10.1007/s00586-004-0749-6

- Cardon, G., De Bourdeaudhuij, I., & De Clercq, D. (2001). Generalization of back education principles by elementary school children: Evaluation with a practical test and a candid camera observation. *Acta Paediatrica (Oslo, Norway: 1992)*, 90(2), 143-150.
- Cardon, G., De Bourdeaudhuij, I., & De Clercq, D. (2002). Knowledge and perceptions about back education among elementary school students, teachers, and parents in Belgium. *The Journal of School Health*, 72(3), 100-106.
- Cardon, G., De Clercq, D., & De Bourdeaudhuij, I. (2000). Effects of back care education in elementary schoolchildren. *Acta Paediatrica*, 89(8), 1010-1017. doi: 10.1080/080352500750043521
- Cardon, G., De Clercq, D., De Bourdeaudhuij, I., & Breithecker, D. (2004). Sitting habits in elementary schoolchildren: A traditional versus a "Moving school." *Patient Education And Counseling*, 54(2), 133-142.
- Cardon, G. M., De Clercq, D. L. R., Geldhof, E. J. A., Verstraete, S., & De Bourdeaudhuij, I. M. M. (2007). Back education in elementary schoolchildren: The effects of adding a physical activity promotion program to a back care program. *European Spine Journal*, 16(1), 125-133. doi: 10.1007/s00586-006-0095-y
- Carter, C. P., Reschly, A. L., Lovelace, M. D., Appleton, J. J., & Thompson, D. (2012). Measuring student engagement among elementary students: Pilot of the Student Engagement instrument—Elementary Version. *School Psychology Quarterly*, 27(2), 61-73.
- Cenciarini, M., Loughlin, P. J., Sparto, P. J., & Redfern, M. S. (2010). Stiffness and damping in postural control increase with age. *IEEE Transactions on Biomedical Engineering*, 57(2), 267-275. doi: 10.1109/tbme.2009.2031 874
- Centers for Disease Control and Prevention. (2010). *The association between school based physical activity, including physical education, and academic performance*. Atlanta, GA: Retrieved from <http://www.letsmove.gov/white-house-task-force-childhood-obesity-report-president>.
- Chen, S.-M., Liu, M.-F., Cook, J., Bass, S., & Lo, S. K. (2009). Sedentary lifestyle as a risk factor for low back pain: A systematic review. *International Archives of Occupational & Environmental Health*, 82(7), 797-806. doi: 10.1007/s00420-009-0410-0
- Chiesa, M., & Hobbs, S. (2008). Making sense of social research: how useful is the Hawthorne Effect? *European Journal of Social Psychology*, 38(1), 67-74. doi: 10.1002/ejsp.401
- Chow, D. H. K., Ou, Z. Y., Wang, X. G., & Lai, A. (2010). Short-term effects of backpack load placement on spine deformation and repositioning error in schoolchildren. *Ergonomics*, 53(1), 56-64. doi: 10.1080/00140130903389050
- Chung, J., & Wong, T. (2007). Anthropometric evaluation for primary school furniture design. *Ergonomics*, 50(3), 323-334.
- Churnin, N. (2010). Kids with Down syndrome, autism and other special needs find calm and balance through yoga classes, *The Dallas Morning News*. Retrieved from

<http://search.ebscohost.com/login.aspx?direct=true&db=nfh&AN=2W62170805756&site=ehost-live>

- Colasacco, J. (2010). A Week of Observations. *Educational Leadership*, 68(4), 59-62.
- Coleman, J., Straker, L., & Ciccarelli, M. (2009). Why do children think they get discomfort related to daily activities? *Work* 32(3), 267-274.
- Creswell, J. W. (2008). *Educational research : Planning, conducting, and evaluating quantitative and qualitative research* (3rd ed.). Upper Saddle River, N.J.: Pearson/Merrill Prentice Hall.
- Cugelman, B., Thelwall, M., & Dawes, P. (2011). Online interventions for social marketing health behavior change campaigns: A meta-analysis of psychological architectures and adherence factors. *J Med Internet Res*, 13(1), e17. doi: v13i1e17 [pii] 10.2196/jmir.1367
- Cunningham, L. S., & Kelsey, J. L. (1984). Epidemiology of musculoskeletal impairments and associated disability. *American Journal of Public Health*, 74(6), 574-579.
- Davis, P. J., & Williams, H. J. (2008). The investigation and management of back pain in children. *Archives of Disease in Childhood—Education and Practice*, 93(3), 73-83.
- DeBar, L. L., Schneider, M., Ford, E. G., Hernandez, A. E., Showell, B., Drews, K. L., . . . White, M. (2009). Social marketing-based communications to integrate and support the HEALTHY study intervention. *Int J Obes (Lond)*, 33 Suppl 4, S52-59. doi: ijo2009117 [pii] 10.1038/ijo.2009.117
- Dekel, H., & Heyman, E. (2008). Ergonomics for children: An educational program for elementary school. *Work*, 31, 253-257.
- Delisle, J. R. (2012). Reaching those we teach: The five Cs of student engagement. *Gifted Child Today*, 35(1), 62-67.
- Derenne, J. L., & Beresin, E. V. (2006). Body image, media, and eating disorders. *Academic Psychiatry*, 30(3), 257-261.
- Deyo, R. A., Mirza, S. K., Martin, B. I., Kreuter, W., Goodman, D. C., & Jarvik, J. G. (2010). Trends, major medical complications, and charges associated with surgery for lumbar spinal stenosis in older adults. *JAMA*, 303(13), 1259-1265. doi: 10.1001/jama.2010.338
- Dhara, P. C., Khaspuri, G., & Sau, S. K. (2009). Complaints arising from a mismatch between school furniture and anthropometric measurements of rural secondary school children during classwork. *Environmental Health and Preventive Medicine*, 14(1), 36-45.
- Diconsiglio, J. (2006). Hospitals equip to meet the bariatric challenge. Rising number of obese patients necessitates specific supplies. *Materials Management in Health Care*, 15(4), 36-39.
- Dockrell, S., Fallon, E., Kelly, M., Masterson, B., & Shields, N. (2003, Aug 24-29, 2003). *An investigation of primary school teachers education on computer related ergonomics*. Paper presented at the XVth Triennial Congress of the International Ergonomics Association, Seoul, Korea.

- Dolan, K. J., & Green, A. (2006). Lumbar spine reposition sense: The effect of a 'slouched' posture. *Manual Therapy, 11*(3), 202-207.
- Dolphens, M., Cagnie, B., Danneels, L., De Clercq, D., De Bourdeaudhuij, I., & Cardon, G. (2011). Long-term effectiveness of a back education programme in elementary schoolchildren: An 8-year follow-up study. *European Spine Journal*. doi: 10.1007/s00586-011-1856-9
- Doyle, W. (1979). Classroom effects. *Theory into Practice, 18*(3), 138.
- Fairbanks North Star Borough (Producer). (2011, 03/20/13). Fairbanks North Star Borough. Retrieved from <http://www.co.fairbanks.ak.us/>
- Fairbanks North Star Borough School District. (2013). Fairbanks North Star Borough School District Retrieved 3/20/13, from <http://www.k12northstar.org/about/faq>
- Fangman, T. D. (2004). Promoting female weight management in 1920s print media: An analysis of Ladies' Home Journal and Vogue magazines. *Family & Consumer Sciences Research Journal, 32*(3), 213-253.
- Feingold, A. J., & Jacobs, K. (2002). The effect of education on backpack wearing and posture in a middle school population. *Work, 18*(3), 287.
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. (2011). *How to design and evaluate research in education* (8th ed.). New York: McGraw-Hill Humanities/Social Sciences/Languages.
- Gale, M. (1997). *The Seated Spine & The Bambach Saddle Seat*. Brookvale, NWS: The Bambach Saddle Seat Pty Ltd.
- Gardner, H. (2011). Promoting learner engagement using multiple intelligences and choice-based instruction. *Adult Basic Education and Literacy Journal, 5*(2), 97-101.
- Gardner, H., & Hatch, T. (1990). Multiple Intelligences Go to School: Educational Implications of the Theory of Multiple Intelligences. Technical Report No. 4: Corporate Source: Center for Technology in Education, New York
- Gardner, W. D., & Osborne, W. A. (1978). *Anatomy of the human body* (Third ed.). Philadelphia: W. B. Saunders.
- Gart, A. (2004). Avoiding backpack injury. *Pediatrics for Parents, 21*(3), 11-11.
- Geldhof, E., Cardon, G., De Bourdeaudhuij, I., Danneels, L., Coorevits, P., Vanderstraeten, G., & De Clercq, D. (2006). Static and dynamic standing balance: test-retest reliability and reference values in 9 to 10 year old children. *European Journal Of Pediatrics, 165*(11), 779-786.
- Geldhof, E., Cardon, G., De Bourdeaudhuij, I., Danneels, L., Coorevits, P., Vanderstraeten, G., & De Clercq, D. (2007). Effects of back posture education on elementary schoolchildren's back function. *European Spine Journal, 16*(6), 829-839.
- Geldhof, E., Cardon, G., De Bourdeaudhuij, I., & De Clercq, D. (2006). Effects of a two-school-year multifactorial back education program in elementary schoolchildren. *Spine, 31*(17), 1965-1973.
- Geldhof, E., Cardon, G., De Bourdeaudhuij, I., & De Clercq, D. (2007). Back posture education in elementary schoolchildren: A 2-year follow-up study. *European Spine Journal, 16*(6), 841-850. doi: 10.1007/s00586-006-0227-4

- Geldhof, E., De Clercq, D., De Bourdeaudhuij, I., & Cardon, G. (2007). Classroom postures of 8-12 year old children. *Ergonomics*, 50(10), 1571-1581. doi: 10.1080/00140130701587251
- Gierlach, P. (2002, June 9-12, 2002). *Physician Perspectives on Children's Musculoskeletal and Vision Disorders in Geneva, Switzerland*. Paper presented at the XVI Annual International Occupational Ergonomics and Safety Conference 2002, Toronto, Canada.
- Gilleard, W., & Smith, T. (2007). Effect of obesity on posture and hip joint moments during a standing task, and trunk forward flexion motion. *International Journal of Obesity*, 31(2), 267-271. doi: 10.1038/sj.ijo.0803430
- Gillespie, R. M. (2002). The physical impact of computers and electronic game use on children and adolescents, a review of current literature. *Work*, 18(3), 249.
- Girlshealth.gov. (2011). Best Bones Forever Retrieved 08/02/11 from <http://www.bestbonesforever.gov/index.cfm>
- Gislason, N. (2009). Mapping school design: A qualitative study of the relations among facilities design, curriculum delivery, and school climate. *Journal of Environmental Education*, 40(4), 17-34.
- Goldstein, S. (2010). Current literature in ADHD. *Journal of Attention Disorders*, 14(2), 196-198. doi: 10.1177/1087054710371180
- Good, T. L. (1988). Observational Research...Grounding Theory in Classrooms. *Educational Psychologist*, 23(4), 375.
- Gracia-Acosta, G. L.-M., K. (2007). Definition of sizes for the design of school furniture for Bogotá schools based on anthropometric criteria. *Ergonomics*, 50(10), 1626-1642.
- Grattan-Smith, P. J., Ryan, M. M., & Procopis, P. G. (2000). Persistent or severe back pain and stiffness are ominous symptoms requiring prompt attention. *Journal of Paediatrics and Child Health*, 36(3), 208-212.
- Hancock, L. (2011). A+ for Finland. *Smithsonian*, 42(5), 94.
- Harcourt, D., & Keen, D. (2012). Learner engagement: Has the child been lost in translation? *Australasian Journal of Early Childhood*, 37(3), 71-78.
- Harkness, E. F., Macfarlane, G. J., Silman, A. J., & McBeth, J. (2005). Is musculoskeletal pain more common now than 40 years ago? Two population-based cross-sectional studies. *Rheumatology (Oxford, England)*, 44(7), 890-895.
- Harreby, M., Nygaard, B., Jessen, T., Larsen, E., Storr-Paulsen, A., Lindahl, A., . . . Laegaard, E. (1999). Risk factors for low back pain in a cohort of 1389 Danish school children: an epidemiologic study. *European Spine Journal: Official Publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society*, 8(6), 444-450.
- Harris, C. M. (2002). Is multimedia-based instruction Hawthorne revisited? Is difference the difference? *Education*, 122(4), 839-843.
- Henderson, A. T., & Berla, N. (1994). *A New Generation of Evidence: The Family Is Critical to Student Achievement*. National Committee for Citizens in Education, Washington D. C.

- Heuer, H., & Sülzenbrück, S. (2012). Mind and movement. *Psychological Research*, 76(2), 159-170. doi: 10.1007/s00426-011-0332-9
- Hill, D. M., & Barth, M. (2004). NCLB and Teacher Retention: Who Will Turn Out the Lights? *Education and the Law*, 16(2-3), 173-181.
- Holden, J. D. (2001). Hawthorne effects and research into professional practice. *Journal of Evaluation in Clinical Practice*, 7(1), 65-70.
- Hollingworth, P. (1996). Back pain in children. *British Journal of Rheumatology*, 35(10), 1022-1028.
- Hoskins, C. N., & Mariano, C. (2004). Research in nursing and health: Understanding and using quantitative and qualitative methods.
- Jacobs, K., & Baker, N. A. (2002). The association between children's computer use and musculoskeletal discomfort. *Work*, 18(3), 221-226.
- Jensen, E. (2005). *Teaching with the Brain in Mind, 2nd Edition*: Association for Supervision and Curriculum Development.
- Jensen, E. P. (2008). A fresh look at brain-based education. *Phi Delta Kappan*, 89(6), 408-417.
- Jeong, B. Y., & Park, K. (1990). Sex differences in anthropometry for school furniture design. *Ergonomics*, 33(12), 1511-1521.
- Katzmarzyk, P. T., Baur, L. A., Blair, S. N., Lambert, E. V., Oppert, J.-M., & Riddoch, C. (2008). International conference on physical activity and obesity in children: summary statement and recommendations. *Applied Physiology, Nutrition & Metabolism*, 33(2), 371-388. doi: 10.1139/h07-176
- Kawakami, K., Phills, C. E., Greenwald, A. G., Simard, D., Pontiero, J., Brnjas, A., . . . Dovidio, J. F. (2012). In perfect harmony: Synchronizing the self to activated social categories. *Journal of Personality and Social Psychology*, 102(3), 562-575. doi: 10.1037/a0025970
- Keen, D., Pennell, D., Muspratt, S., & Poed, S. (2011). Teacher self-report on learner engagement strategies in the early years classroom. *Australian Educational Researcher*, 38(3), 293-310.
- Kelleher, D. C., Merrill, C. T., Cottrell, L. T., Nadler, E. P., & Burd, R. S. (2013). Recent national trends in the use of adolescent inpatient bariatric surgery: 2000 through 2009. *JAMA Pediatrics*, 167(2), 126-132. doi: 10.1001/2013.jamapediatrics.286
- Keller, T. S., Colloca, C. J., Harrison, D. E., Harrison, D. D., & Janik, T. J. (2005). Influence of spine morphology on intervertebral disc loads and stresses in asymptomatic adults: Implications for the ideal spine. *Spine Journal*, 5(3), 297-309. doi: 10.1016/j.spinee.2004.10.050
- Kirk, R. (2006). Straighten Up America Retrieved 09/03/11 from <http://www.straightenupamerica.org/>
- Knight, G., & Noyes, J. (1999). Children's behaviour and the design of school furniture. *Ergonomics*, 42(5), 747-760. doi: 10.1080/001401399185423
- Kovacs, F. M., Gestoso, M., Gil del Real, M. T., Lopez, J., Mufraggi, N., & Ignacio Mendez, J. (2003). Risk factors for non-specific low back pain in schoolchildren and their parents: A population based study. *Pain (03043959)*, 103(3), 259.

- Kratenova, J., Zejglicova, K., Maly, M., & Filipova, V. (2007). Prevalence and Risk Factors of Poor Posture in School Children in the Czech Republic. *School Health*, 77(3), 131-137.
- Kriemler, S., Zahner, L., Schindler, C., Meyer, U., Hartmann, T., Hebestreit, H., . . . Puder, J. J. (2010). Effect of school based physical activity programme (KISS) on fitness and adiposity in primary schoolchildren: Cluster randomised controlled trial. *BMJ (Clinical Research Ed.)*, 340, c785-c785. doi: 10.1136/bmj.c785
- Kristjansdottir, G., & Rhee, H. (2002). Risk factors of back pain frequency in schoolchildren: A search for explanations to a public health problem. *Acta Paediatrica*, 91(7), 849-854.
- Lafond, D., Descarreaux, M., Normand, M., & Harrison, D. (2007). Postural development in school children: a cross-sectional study. *Chiropractic & Osteopathy*, 15(1), 1-0.
- Lakin, J. L., Chartrand, T. L., & Arkin, R. M. (2008). I am too just like you: Nonconscious mimicry as an automatic behavioral response to social exclusion. *Psychological Science*, 19(8), 816-822. doi: 10.1111/j.1467-9280.2008.02162.x
- Liou, Y. M., Liou, T.-H., & Chang, L.-C. (2010). Obesity among adolescents: Sedentary leisure time and sleeping as determinants. *Journal of Advanced Nursing*, 66(6), 1246-1256. doi: 10.1111/j.1365-2648.2010.05293.x
- Lippke, S., & Ziegelman, J. P. (2008). Theory-based health behavior change: Developing, testing, and applying theories for evidence-based interventions. *Applied Psychology: An International Review*, 57(4), 698-716. doi: 10.1111/j.1464-0597.2008.00339.x
- Liu-Ambrose, T., Khan, K. M., Eng, J. J., Lord, S. R., & McKay, H. A. (2004). Balance confidence improves with resistance or agility training. *Gerontology*, 50(6), 373-382. doi: 10.1159/000080175
- Loye, B., Epstein, E., Walsh, M., & Colford, S. (2011). The Back Straight Boys Retrieved 11/23/11, from <http://backstraightboys.com/BackStraightBoys/Welcome.html>
- Lui, D. P. Y., Szeto, G. P. Y., & Jones, A. Y. M. (2011). The pattern of electronic game use and related bodily discomfort in Hong Kong primary school children. *Computers & Education*, 57(2), 1665-1674. doi: 10.1016/j.compedu.2011.03.008
- Lunenburg, F. C., & Irby, B. J. (2011). Instructional strategies to facilitate learning. *International Journal of Educational Leadership Preparation*, 6(4).
- Lytle, L. (2009). Examining the etiology of childhood obesity: The IDEA study. *American Journal of Community Psychology*, 44(3/4), 338-349. doi: 10.1007/s10464-009-9269-1
- Malaty, H. M., Abudayyeh, S., Fraley, K., Graham, D. Y., Gilger, M. A., & Hollier, D. R. (2007). Recurrent abdominal pain in school children: Effect of obesity and diet. *Acta Paediatrica*, 96(4), 572-576. doi: 10.1111/j.1651-2227.2007.00230.x
- Maloiy, G., Heglund, N., Prager, L., Cavagna, G., & Taylor, C. R. (1986). Energetic cost of carrying loads: Have African women discovered an economic way? *Nature*, 319, 668-669.

- Mandal, T. (2011). Better furniture for work and study. Retrieved 12/21/11, from <http://www.bodyconsciousdesign.com/bcd>
- Marigold, D. S., Eng, J. J., Dawson, A. S., Inglis, J. T., Harris, J. E., & Gylfadóttir, S. (2005). Exercise leads to faster postural reflexes, improved balance and mobility, and fewer falls in older persons with chronic stroke. *Journal of the American Geriatrics Society*, 53(3), 416-423. doi: 10.1111/j.1532-5415.2005.53158.x
- McAllister, P. (2009). *Manthorology: The Science of Why the Modern Male Is Not the Man He Used to Be* New York: St. Martin's Press.
- McNaught, H. (2001). Ergonomics just as vital in classroom. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=nfh&AN=200107161014783201&site=ehost-live>
- Melzer, I., Benjuya, N., & Kaplanski, J. (2001). Age-related changes of postural control: Effect of cognitive tasks. *Gerontology*, 47(4), 189-194.
- Méndez, F. J., & Gómez-Conesa, A. (2001). Postural hygiene program to prevent low back pain. *Spine*, 26, 1280-1286.
- Mikkelsen, M., El-Metwally, A., Kautiainen, H., Auvinen, A., Macfarlane, G. J., & Salminen, J. J. (2008). Onset, prognosis and risk factors for widespread pain in schoolchildren: A prospective 4-year follow-up study. *Pain*, 138(3), 681-687.
- Milanese, S., & Grimmer, K. (2004). School furniture and the user population: An anthropometric perspective. *Ergonomics*, 47(4), 416-426.
- Mokdad, M., & Al-Ansari, M. (2009). Anthropometrics for the design of Bahraini school furniture. *International Journal of Industrial Ergonomics*, 39(5), 728-735.
- Molenbroek, J., Kroon-Ramaekers, Y., & Snijders, C. (2003). Revision of the design of a standard for the dimensions of school furniture. *Ergonomics*, 46(7), 681-694.
- Moley, P. F., Bandre, P. E., & George, J. E. (2011). Moving beyond readability: Considering choice, motivation and learner engagement. *Theory into Practice*, 50(3), 247-253.
- Moore, M. J., White, G. L., & Moore, D. L. (2007). Association of relative backpack weight with reported pain, pain sites, medical utilization, and lost school time in children and adolescents. *Journal of School Health*, 77(5), 232-239. doi: 10.1111/j.1746-1561.2007.00198.x
- Murphy, S., Buckle, P., & Stubbs, D. (2004). Classroom posture and self-reported back and neck pain in schoolchildren. *Applied Ergonomics*, 35(2), 113. doi: 10.1016/j.apergo.2004.01.001
- Murphy, S., Buckle, P., & Stubbs, D. (2007). A cross-sectional study of self-reported back and neck pain among English schoolchildren and associated physical and psychological risk factors. *Applied Ergonomics*, 38(6), 797-804.
- National Safety Council. (2009). Backpack Safety Retrieved 08/17/2011, from http://www.nsc.org/news_resources/Resources/Pages/SafetyHealthFactSheets.aspx
- Neave, H. R. (1978). *Statistics Tables for Mathematicians, Engineers, Economists and the Behavioral and Management Sciences*. London: George Allen & Unwin.
- NFL. (2011). Fuel up to play 60 Retrieved 09/10/11, from <http://www.fueluptoplay60.com/>

- Noda, W., & Tanaka-Matsumi, J. (2009). Effect of a classroom-based behavioral intervention package on the improvement of children's sitting posture in Japan. *Behavior Modification*, 33(2), 263-273.
- Obama, M. (2010). Let's Move 02/09/2010. Retrieved 09/08/11, from <http://www.letsmove.gov/>
- Obama, M. (2013). *First Lady Michelle Obama remarks to kids at Let's Move! Active Schools launch.*: FDCH Political Transcripts Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=mth&AN=32V2139772334&site=ehost-live>.
- Olivier, I., Palluel, E., & Nougier, V. (2008). Effects of attentional focus on postural sway in children and adults. *Experimental Brain Research*, 185(2), 341-345.
- Online Etymology Dictionary. (2011). Hygiene Retrieved 08/30/11, from <http://dictionary.reference.com/browse/Hygiene>
- Oregon State Dept. of Education. (2009). Computer Ergonomics for Elementary School Retrieved 08/09/11, from <http://www.orosha.org/cergos/index.html>
- Orr, K. (2009). Svaroopa yoga therapy for children with Asperger's Syndrome. *Yoga Therapy in Practice*, 5(1), 27-30.
- Pan, W. H., Lee, M. S., Chuang, S. Y., Lin, Y. C., & Fu, M. L. (2008). Obesity pandemic, correlated factors and guidelines to define, screen and manage obesity in Taiwan. *Obesity Reviews*, 9, 22-31. doi: 10.1111/j.1467-789X.2007.00434.x
- Peck, H. L., Kehle, T. J., Bray, M. A., & Theodore, L. A. (2005). Yoga as an intervention for children with attention problems. *School Psychology Review*, 34(3), 415-424.
- Perez-Christiaens, N. (1982a). *Bien Savoir Porter Sur la Tete, une therapeutique paysanne*. Paris, France: Institut Supérieur d'Aplomb.
- Perez-Christiaens, N. (1982b). *Le bien-etre Africain et l'aplomb*. Paris, France: Institut Supérieur D'Aplomb.
- Phélip, X. (1999). Why the back of the child? *European Spine Journal: Official Publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society*, 8(6), 426-428.
- Pohl, J. F., Stephen, M., & Wilson, D. P. (2006). Pediatric Obesity: Impact and Surgical Management. *Southern Medical Journal*, 99(8), 833-844.
- Polanczyk, G., Silva De Lima, M., Horta, B. L., Biederman, J., & Rohde, L. A. (2007). The worldwide prevalence of ADHD: a systematic review and metaregression analysis. [online journal]. *American Journal of Psychiatry*, 164(6), 942-948.
- Private School Review. (2003 – 2013). Fairbanks North Star Borough Private Schools Retrieved 03/20/13, from http://www.privateschoolreview.com/county_private_schools/stateid/AK/county/2090
- Ratey, J. J., & Hagerman, E. (2008). *Spark: The revolutionary new science of exercise and the brain*. New York: Little, Brown and Co.
- Reneman, M. F., Poels, B. J. J., Geertzen, J. H. B., & Dijkstra, P. U. (2006). Back pain and backpacks in children: Biomedical or biopsychosocial model? *Disability & Rehabilitation*, 28(20), 1293-1297.

- Resnick, R. M. (2011). School market size, growth and the shift to digital resources in K-12 classrooms. *Publishing Research Quarterly*, 27(2), 169-177. doi: 10.1007/s12109-011-9209-4
- Reynolds, D. (2007). Restraining Golem and harnessing Pygmalion in the classroom: A laboratory study of managerial expectations and task design. *Academy of Management Learning & Education*, 6(4), 475-483. doi: 10.5465/amle.2007.27694947
- Robinson, L. (2011, 01/17/2011). How the science of behavior change can help environmentalists.
- Rolf, I. (1978). *Rolfing and Physical Reality* (Reprint ed.). Rochester, VT: Healing Arts Press.
- Rolf, I. P. (1977). *Rolfing*. Rochester, VT: Healing Arts Press.
- Roth, I. (2011, November 15, 2011). *Presentation by Elders on Education*. Paper presented at the 2011 Interior Education Summit, Fairbanks, AK.
- Salminen, J. J., Erkintalo, M. O., Pentti, J., Oksanen, A., & Kormano, M. J. (1999). Recurrent low back pain and early disc degeneration in the young. *Spine*, 24(13), 1316-1321.
- Sanford, M. W. (2006). *Waking* (1st ed.): Rodale.
- Savanur, C. S., Altekari, C. R., & De, A. (2007). Lack of conformity between Indian classroom furniture and student dimensions: proposed future seat/table dimensions. *Ergonomics*, 50(10), 1612-1625.
- Scheurer, T. E. (1990). Goddesses and goldiggers: images of women in popular music of the 1930s. *Journal of Popular Culture*, 24(1), 23-38.
- Schmid, A. A., Van Puymbroeck, M., & Kocejka, D. M. (2010). Effect of a 12-week yoga intervention on fear of falling and balance in older adults: A pilot study. *Archives of Physical Medicine and Rehabilitation*, 91(4), 576-583.
- Schultz, L. J. H. (2003, Aug 24-29, 2003). *ErgoKids: How will future generations deal with current exposures* Paper presented at the XVth Triennial Congress of the International Ergonomics Association, Seoul, Korea.
- Schwartz, K. (2006). Help students own their yoga practice. *Yoga Therapy in Practice*, 2(3), 18-19.
- Shah, N. (2011). New grants to aid healthy schools. *Education Week*, 30(23), 4-4.
- Sigurdsson, S., Ring, B., Needham, M., Boscoe, J., & Silverman, K. (2011). Generalization of posture training to computer workstations in an applied setting. *Journal of Applied Behavior Analysis*, 44(1), 157-161. doi: 10.1901/jaba.2011.44-157
- Silver, D. (2011). Using the "Zone" to help reach every learner. *Kappa Delta Pi Record*, 48(1), 28-31.
- Singer, C. (1957). *A Short History of Anatomy from the Greeks to Harvey*. New York: Dover Publications.
- Skinner, B. F. (1988). A system of behavior. In L. T. Benjamin, Jr. (Ed.), *A history of psychology: Original sources and contemporary research*. (pp. 452-457). New York & England: McGraw-Hill.

- Sousa, D. A. (2009). *How the brain influences behavior*. Thousand Oaks, CA: Corwin Press.
- Spruijt-Metz, D. (2011). Etiology, treatment, and prevention of obesity in childhood and adolescence: A decade in review. *Journal of Research on Adolescence (Wiley-Blackwell)*, 21(1), 129-152. doi: 10.1111/j.1532-7795.2010.00719.x
- Stanton, A. (Writer) & A. Stanton (Director). (2008). WALL-E [Motion picture]. In W. D. H. Entertainment (Producer), *WALL-E*. Burbank, CA.
- Stead, M., Hastings, G., & McDermott, L. (2007). The meaning, effectiveness and future of social marketing. *Obesity Reviews, Supplement 1*, 189-193. doi: OBR340 [pii] 10.1111/j.1467-789X.2007.00340.x
- Stellefson, M., & Eddy, J. M. (2008). Health education and marketing processes: 2 related methods for achieving health behavior change. *Am J Health Behav*, 32(5), 488-496. doi: 10.5555/ajhb.2008.32.5.488
- Stovitz, S. D., Pardee, P. E., Vazquez, G., Duval, S., & Schwimmer, J. B. (2008). Musculoskeletal pain in obese children and adolescents. *Acta Paediatrica*, 97(4), 489-493. doi: 10.1111/j.1651-2227.2008.00724.x
- Straker, L., Briggs, A., & Greig, A. (2002). The effect of individually adjusted workstations on upper quadrant posture and muscle activity in school children. *Work (Reading, Mass.)*, 18(3), 239-248.
- Straker, L., Burgess-Limerick, R., Pollock, C., & Maslen, B. (2009). The influence of desk and display design on posture and muscle activity variability whilst performing information technology tasks. *Applied Ergonomics*, 40(5), 852-859. doi: 10.1016/j.apergo.2008.09.004
- Straker, L., Maslen, B., Burgess-Limerick, R., & Pollock, C. (2009). Children have less variable postures and muscle activities when using new electronic information technology compared with old paper-based information technology. *Journal of Electromyography and Kinesiology: Official Journal of the International Society of Electrophysiological Kinesiology*, 19(2), e132-e143.
- Straker, L., & Mathiassen, S. E. (2009). Increased physical work loads in modern work—a necessity for better health and performance? *Ergonomics*, 52(10), 1215-1225.
- Straker, L., Skoss, R., Burnett, A., & Burgess-Limerick, R. (2009). Effect of visual display height on modelled upper and lower cervical gravitational moment, muscle capacity and relative strain. *Ergonomics*, 52(2), 204-221. doi: 10.1080/00140130802331609
- Strauss, A., & Corbin, J. (1990). *Basics of Qualitative Research*. Newbury Park, CA: Sage Publications, Inc.
- Tanner, D. (2012). *Using Statistics to Make Educational Decisions*. Los Angeles: Sage.
- Teddlie, C., Tashakkori, A., & Johnson, B. (2008). Emergent techniques in the gathering and analysis of mixed methods data. In S. N. Hesse-Biber & P. Leavy (Eds.), *Handbook of emergent methods*. (pp. 389-413). New York: Guilford Press.
- Templeton, R. A., & Jensen, R. A. (1996, April 8–12). *Can adding movement to learning improve the classroom environment?* Paper presented at the American Educational Research Association, New York.

- Thompson, S. (2006, January 10). School furniture major cause of adult back pain, says expert, *Irish Times*. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=nfh&AN=9FY2511497703&site=ehost-live>
- Tinning, R. (2001). Physical education and back health: negotiating instrumental aims and holistic bodywork practices. *European Physical Education Review*, 7(2), 191.
- Todd, M. E. (1937). *The Thinking Body, A Study of the Balancing Forces of Dynamic Man*. Brooklyn, NY: Dance Horizons.
- Trevelyan, F. C., & Legg, S. J. (2011). Risk factors associated with back pain in New Zealand school children. *Ergonomics*, 54(3), 257-262.
- Troussier, B., Tesniere, C., Fauconnier, J., Grison, J., Juvin, R., & Phelip, X. (1999). Comparative study of two different kinds of school furniture among children. *Ergonomics*, 42(3), 516-526.
- Ullmann, G., Williams, H. G., Hussey, J., Durstine, J. L., & McClenaghan, B. A. (2010). Effects of Feldenkrais exercises on balance, mobility, balance confidence, and gait performance in community-dwelling Adults age 65 and older. *Journal of Alternative & Complementary Medicine*, 16(1), 97-105. doi: 10.1089/acm.2008.0612
- United States Government. (2011). President's Council on Fitness, Sports & Nutrition Retrieved 08/15/11, from <http://www.fitness.gov/>
- US Census Bureau. (2010). State & County QuickFacts Retrieved 03/10/12, from <http://quickfacts.census.gov/qfd/states/02000.html>
- USDOL. (2011). US Dept. of Labor Occupational Safety and Health Administration Computer Workstations Retrieved 08/14/11, from <http://www.osha.gov/SLTC/etools/computerworkstations/>
- Vernikos, J. (2011). *Sitting Kills Moving Heals*. Fresno, CA: Quill Driver Books.
- Vidal, J., Borrás, P. A., Ortega, F. B., Cantalops, J., Ponseti, X., & Palou, P. (2011). Effects of postural education on daily habits in children. *International Journal of Sports Medicine*, 32(4), 303-308.
- Watson, J. C., Payne, R. C., Chamberlain, A. T., Jones, R. K., & Sellers, W. I. (2008). The energetic costs of load-carrying and the evolution of bipedalism. *Journal of Human Evolution*, 54(5), 675-683. doi: 10.1016/j.jhevol.2007.10.004
- Watson, K. D., Papageorgiou, A. C., Jones, G. T., Taylor, S., Symmons, D. P. M., Silman, A. J., & Macfarlane, G. J. (2002). Low back pain in schoolchildren: Occurrence and characteristics. *Pain*, 97(1-2), 87-92.
- Weeks, D. L., Forget, R., Mouchnino, L., Gravel, D., & Bourbonnais, D. (2003). Interaction between attention demanding motor and cognitive tasks and static postural stability. *Gerontology*, 49(4), 225-232. doi: 10.1159/000070402
- Weger, B. (2011). Social marketing: The science of behavior change Retrieved 08/08/11, from <http://www.imageonepr.com>
- White House Task Force on Childhood Obesity. (2010). Solving the problem of childhood obesity within a generation. Washington, D.C.
- White, T. D. (2000). *Human Osteology* (Second ed.). San Diego, CA: Academic Press.

- Widhe, T. (2001). Spine: posture, mobility and pain. A longitudinal study from childhood to adolescence. *European Spine Journal*, 10(2), 118-123.
- Wilke, E., & Colley-Gilbert, B. (2011). Development of a stand-based school desk to reduce childhood obesity (Vol. 150,000). College Station, TX: NIH.
- Williams, C. D., & Jacobs, K. (2002). The effectiveness of a home-based ergonomics intervention on the proper use of computers by middle school children. *Work*, 18(3), 261-268.
- Williams, I. M. (2002, June 9-10). *Students' Musculoskeletal and Visual Concerns*. . Paper presented at the XVI Annual International Occupational Ergonomics and Safety Conference, Toronto, Canada.
- Williams, K., Steinberg, L., & Petronis, J. (2003). Therapeutic application of Iyengar Yoga for healing chronic low back pain. *International Journal of Yoga Therapy*, 13(1), 55-67.
- Wingrat, J. K., & Exner, C. E. (2005). The impact of school furniture on fourth-grade children's on-task and sitting behavior in the classroom: A pilot study. *Work*, 25(3), 263-272.
- Wolraich, M., Lambert, W., Doffing, M., Bickman, L., Simmons, T., & Worley, K. (2003). Psychometric Properties of the Vanderbilt ADHD Diagnostic Parent Rating Scale in a Referred Population. *Journal of Pediatric Psychology*, 28(8), 559-568.
- Yosifon, D., & Stearns, P. N. (1998). The Rise and Fall of American Posture. *The American Historical Review*, 103 (October 1998), 1057-1095.

Appendix A

Postural Alignment Visual and Verbal PowerPoint Loop Messages

These were verbalized at regular intervals throughout the school day from 9 to 15 minutes apart. They are typed as they are seen on the PowerPoint presentation.

Sit up and Relaxed

Tall Relaxed Spine

Sit Tall

Stand Tall

Sit Tall on Sit Bones

Stretch your spine tall

SIT TALL ANYWHERE

Remain Tall

Tall Relaxed Spine

Sit Naturally Tall

Stand in Balance

Straight Tall Spine

Sit Tall

Sit Tall

Sit up and Relaxed

Sit Tall and Comfortable

Appendix B

FNSBSD Research Regulations

Research & Accountability Department
Fairbanks North Star Borough School District
520 Fifth Avenue
Fairbanks, AK 99701
Phone: 907-452-2000 ext. 340
Fax: 907-328-0899
E-Mail: bernice.creek@k12northstar.org
Website: www.k12northstar.org/research-accountability

External Research

Approved application submission and data collection time periods per FNSBSD AR 1250:

No research applications will be accepted after the start of the fourth quarter of the current school year.

To avoid undue inconvenience to building personnel and students, no research activities will be allowed:

- *During the two weeks after the opening of school or during the two weeks prior to the closing of school,*
- *One week before and one week after the winter and spring vacation periods,*
- *Two weeks prior to and during any state-mandated or district-wide testing,*
- *During the first week of the second semester,*
- *Where there are already a number of research projects underway,*
- *Where a number of research projects have already been conducted.*

Fairbanks North Star Borough School District

External research is defined as research initiated by individuals not employed by the school district or by district employees who want to perform research for non-job-related purposes (e.g. research required by a college course).

What is Research?

Research is defined as any data collection activity, which seeks to obtain information from students, staff, or parents including (but not limited to) opinion polls, focus groups, interviews, and surveys.

Application forms and additional information are available at:
www.k12northstar.org/research-accountability

Instructional time is valuable. Research that takes time away from the instructional day will not be approved.

Proposals that require parental consent (i.e., those that ask questions of students that FERPA or Alaska Statute forbid without parental approval) will not be approved.

Research proposals will not be approved unless the research has clear, direct, and immediate benefit to the district in terms of informing educational practice.

Individuals wishing to conduct any research activity in the Fairbanks North Star Borough School District must submit to the Research and Accountability Department the following:

- One signed copy of the external application (available at the Research & Accountability office located at 520 Fifth Avenue in Fairbanks and online at: www.k12northstar.org/research-accountability) with all required attachments.

- One complete application sent electronically to: bernice.creek@k12northstar.org

Ø Research conducted by district employees must not involve students or staff in their own building or over whom they have authority. **The research must be conducted outside of the staff member's duty day.**

Ø Only those research activities initiated by the School Board or Superintendent are exempt from the application process. (See FNSBSD AR 1250 for further information.)

Ø All representations made to participants respecting anonymity, confidentiality, purpose and procedures must be honored by the researcher.

Ø Data collected may only be used for the purposes of the study approved.

Ø Any media regarding the research must be approved first by the Director of Research & Accountability.

Review Process

The Research & Accountability Department will review all research applications to ensure compliance with Family Educational Rights & Privacy Act (FERPA), Protection of Pupil Rights Amendment (PPRA) and Alaska Statutes. The proposal will then be submitted for review to a committee of at least three district staff members (per FNSBSD AR 1250). This process takes approximately three (3) weeks to complete.

The committee will evaluate the application on four components:

1. Relevance – The research must further the mission of the school district.
2. Quality – The research must demonstrate a high standard of quality (sampling methods, instruments, statistical analysis, data interpretation, etc.).
3. District Benefit – The research must have a clear, direct, and immediate benefit to the district in terms of informing educational practice.
4. District Burden – The district will only accommodate research that requires a reasonable amount of time and effort from district staff. Research should not take time away from instructional activities.

When a decision has been reached by the review committee, notification will be sent to the researcher. Three decisions are possible:

Approval – Researcher may proceed with contacting individual school principals to initiate research.

Approval with Modifications – If the study is approved with modifications, the researcher must provide a written response indicating compliance with the modifications before final approval is granted.

Denial – Research that does not meet requirements as set forth in FNSBSD AR 1250.

Appendix C

IRB Approval Letter May

Institutional Review Board
909 N Koyukuk Dr. Suite 212
P.O. Box 757270
Fairbanks, Alaska 99775-7270
(907) 474-7800
(907) 474-5444 fax
fyirb@uaf.edu
www.uaf.edu/irb

May 18, 2012

To: Abel Bult-Ito, Ph.D.
Principal Investigator

From: University of Alaska Fairbanks IRB
Re: [336143-1] How Classroom Environment, Movement, Ergonomics, and Posture Effects
Learning Engagement in School Aged Children

Thank you for submitting the New Project referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title: How Classroom Environment, Movement, Ergonomics, and Posture Effects
Learning Engagement in School Aged Children
Received: May 4, 2012
Expedited Category: 7

Action: APPROVED

Effective Date: May 18, 2012
Expiration Date: May 18, 2013

This action is included on the June 14, 2012 IRB Agenda. No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.

Appendix D

IRB Approval Letter July

Institutional Review Board
909 N Koyukuk Dr. Suite 212
P.O. Box 757270
Fairbanks, Alaska 99775-7270
(907) 474-7800
(907) 474-5444 fax
fyirb@uaf.edu
www.uaf.edu/irb

July 27, 2010

To: Abel Bult-Ito, Ph.D.
Principal Investigator

From: University of Alaska Fairbanks IRB

Re: [173369-4] Will postural alignment affect attention in school-aged children?

Thank you for submitting the Amendment/Modification referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title: Will postural alignment affect attention in school-aged children?

Received: July 27, 2010

Expedited Category: 7

Action: APPROVED

Effective Date: July 27, 2010

Expiration Date: July 27, 2011

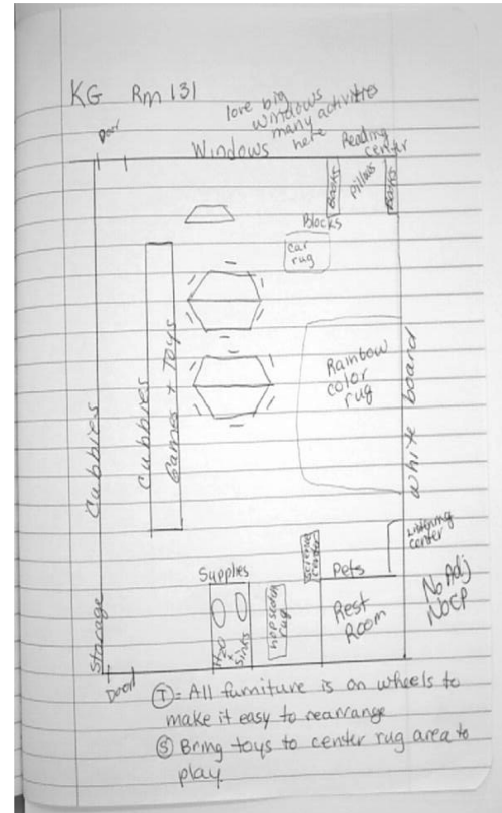
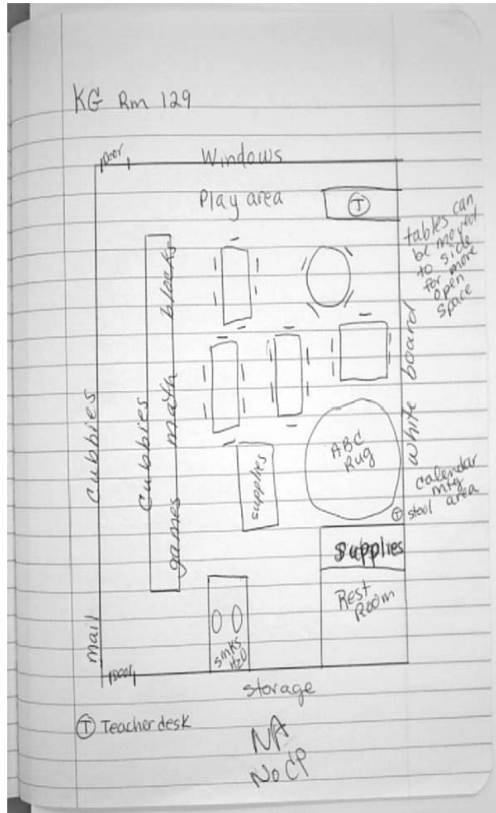
Required Information: Based on final administrative review, PI and graduate student have responded adequately to the reviewers' comments and requests.

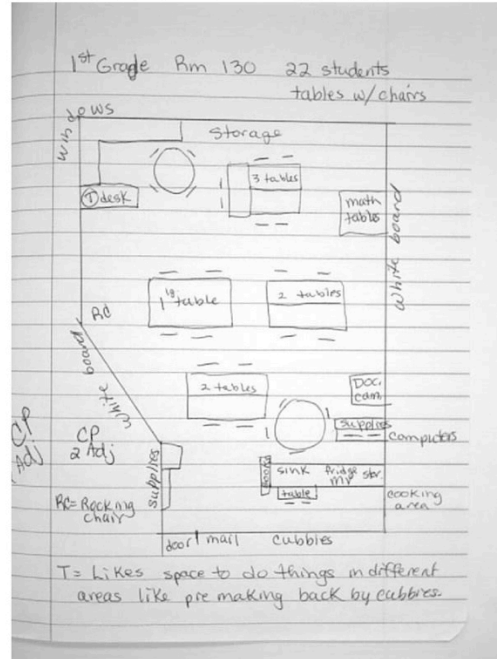
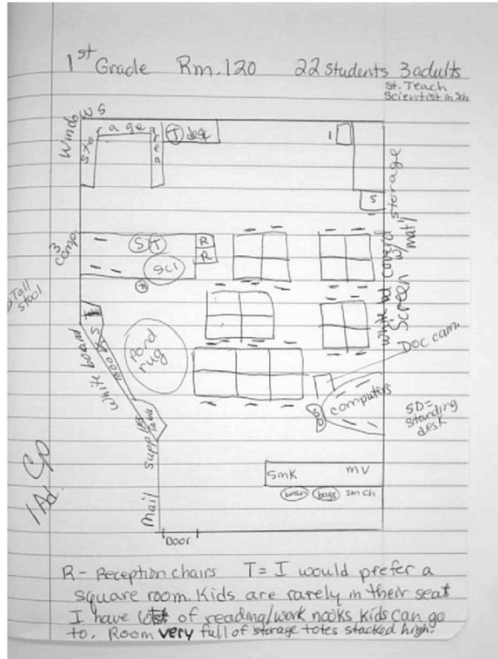
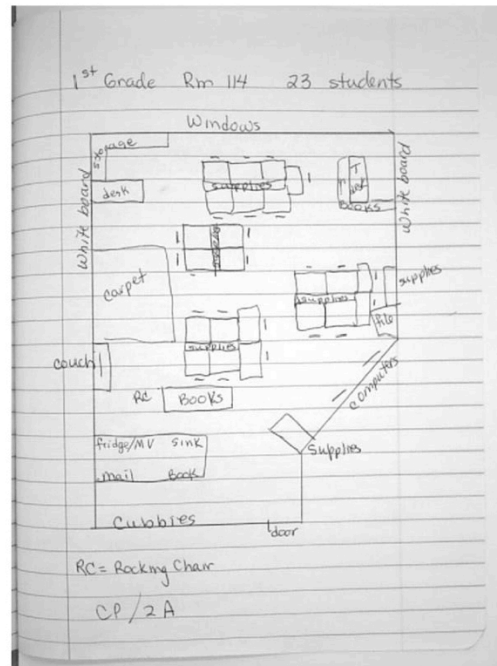
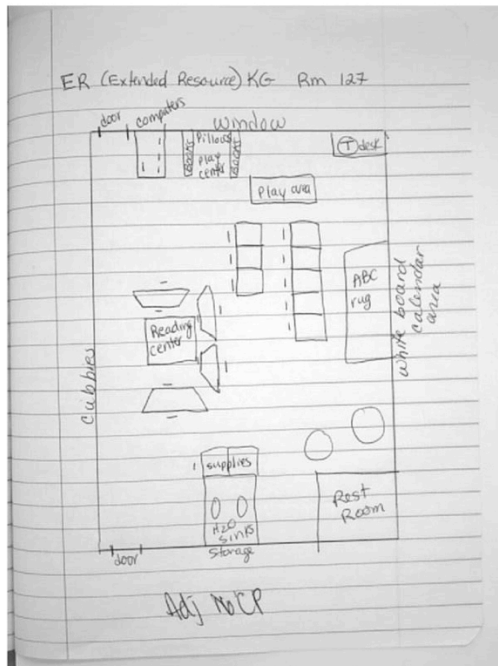
This action will be included on the next IRB Agenda (date and time TBD).

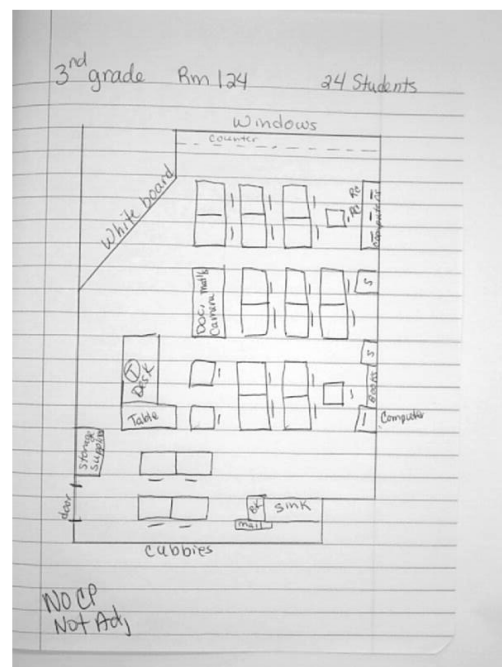
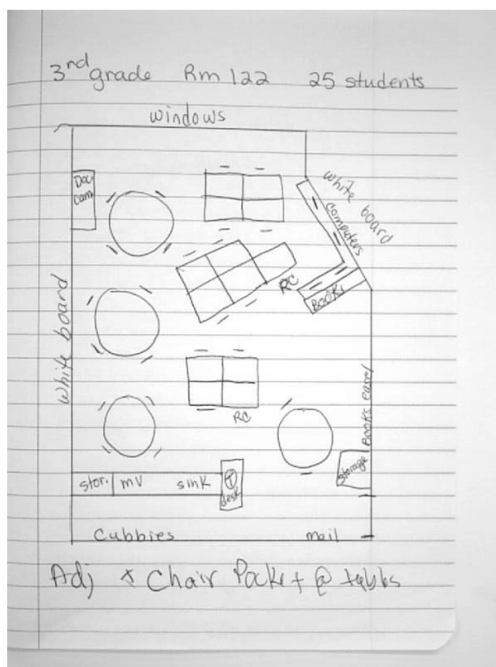
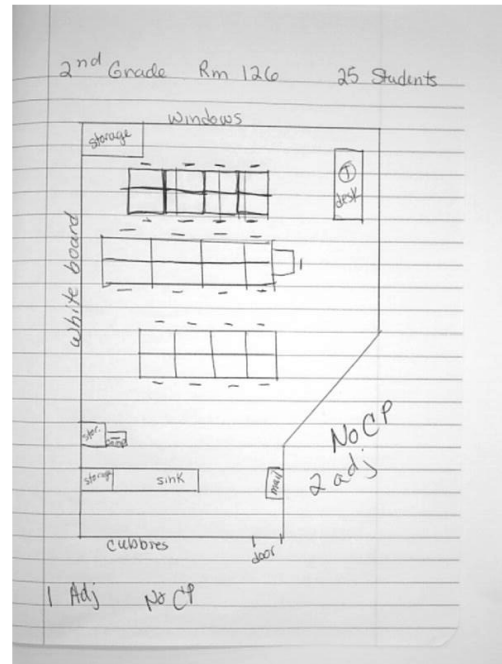
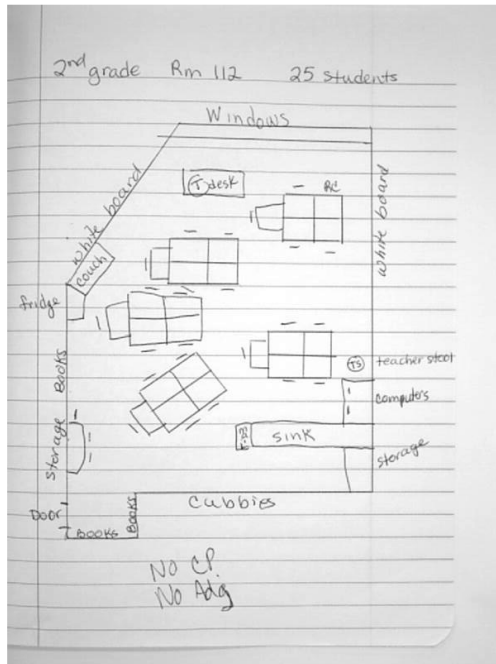
No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.

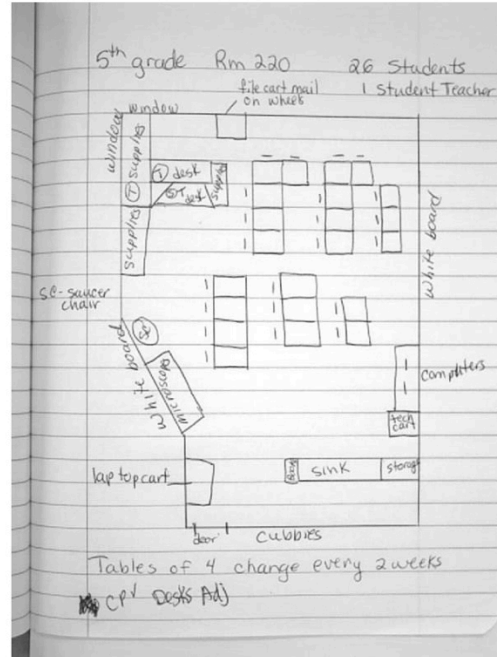
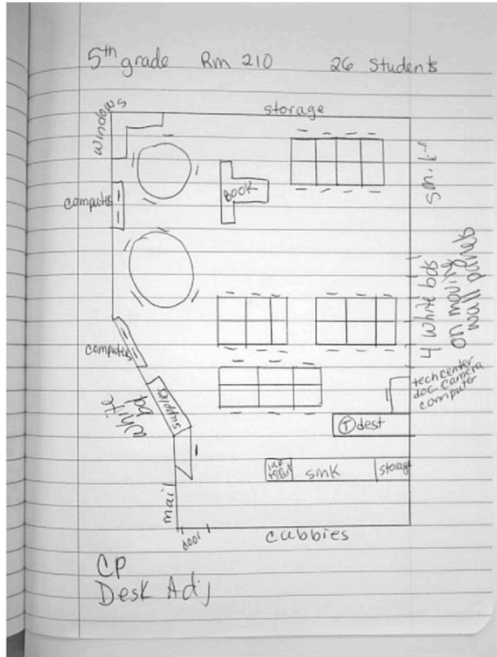
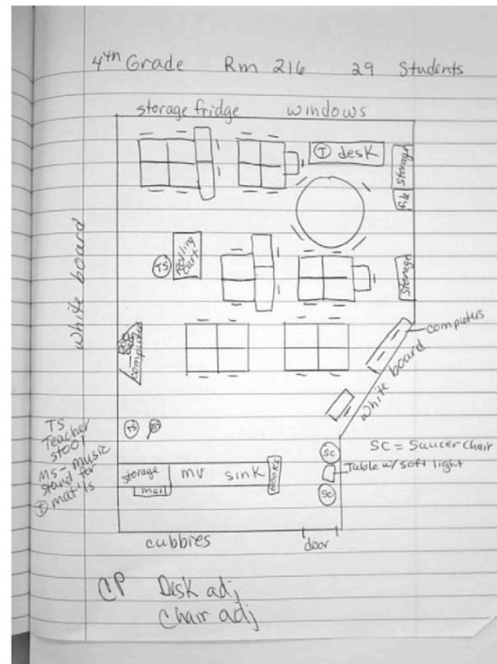
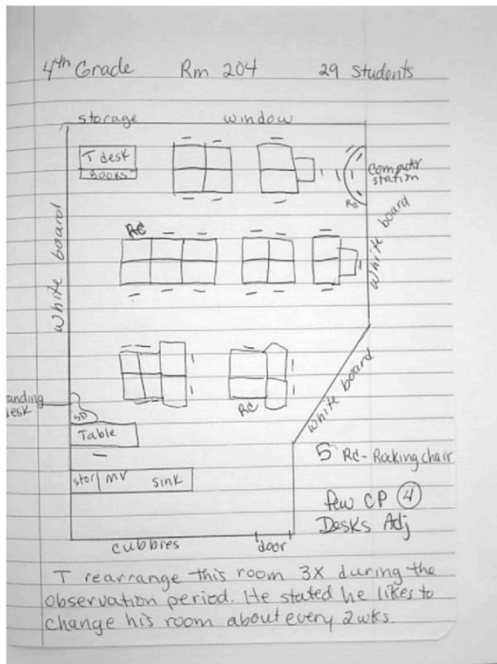
Appendix E

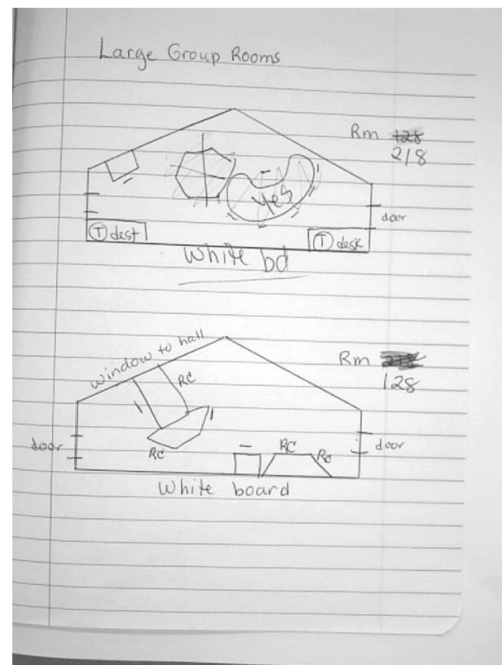
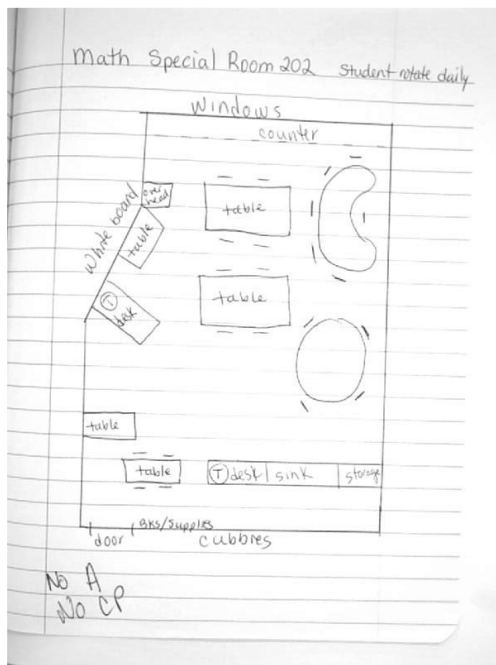
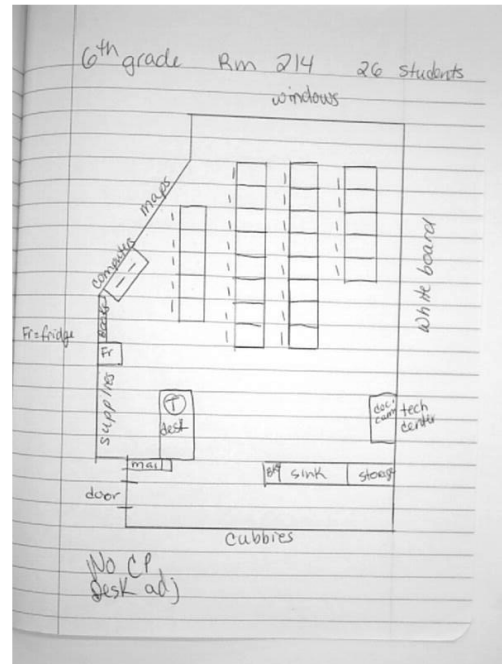
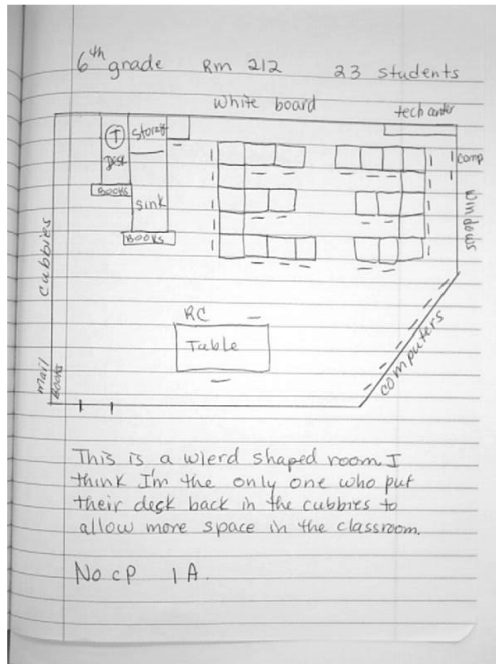
Classroom Sketches

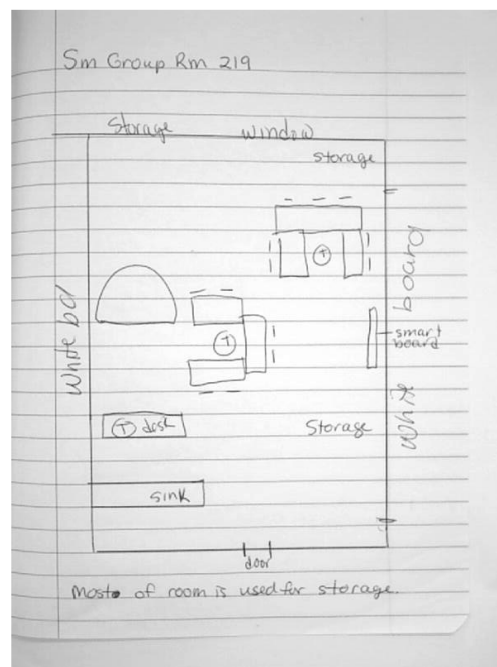
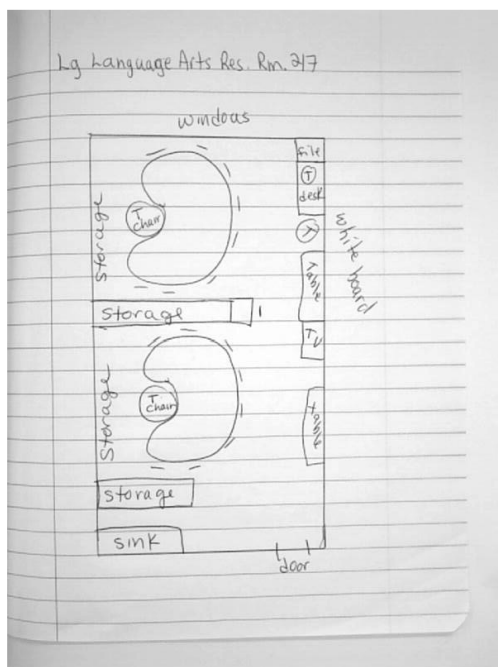
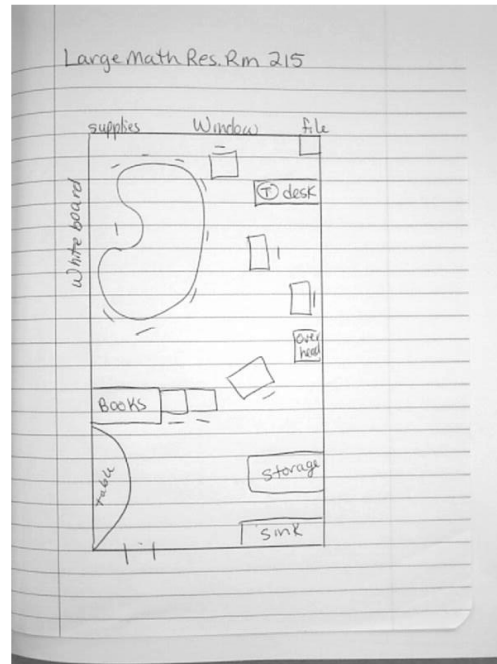
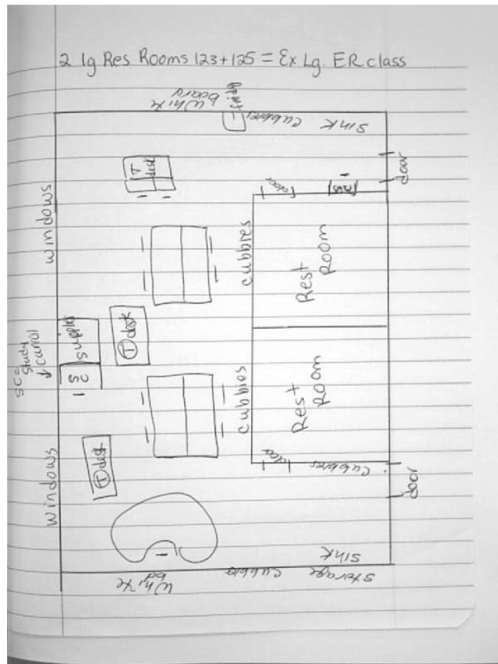


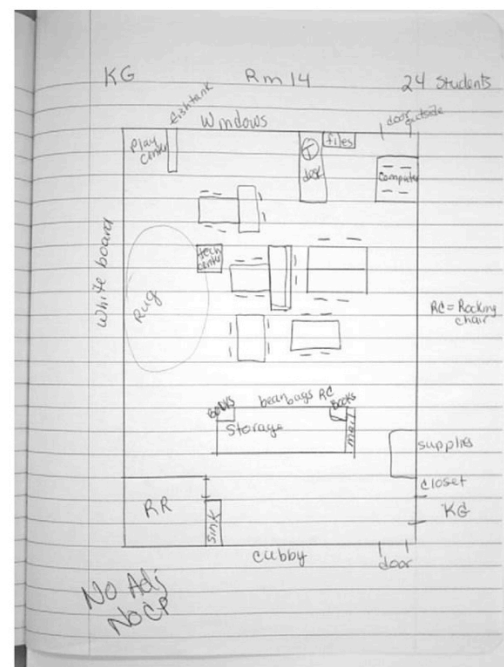
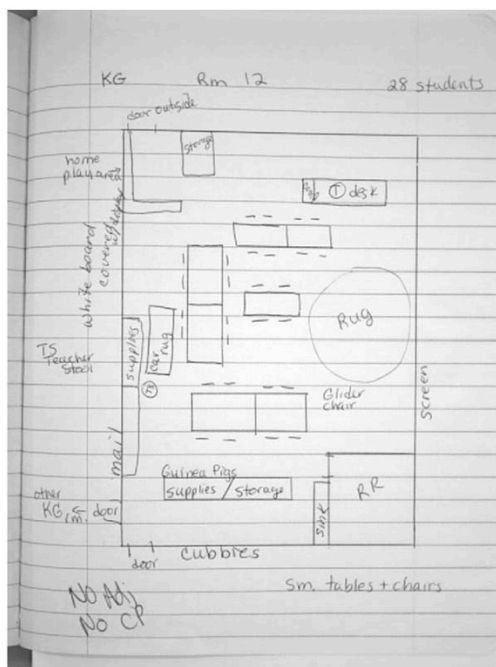
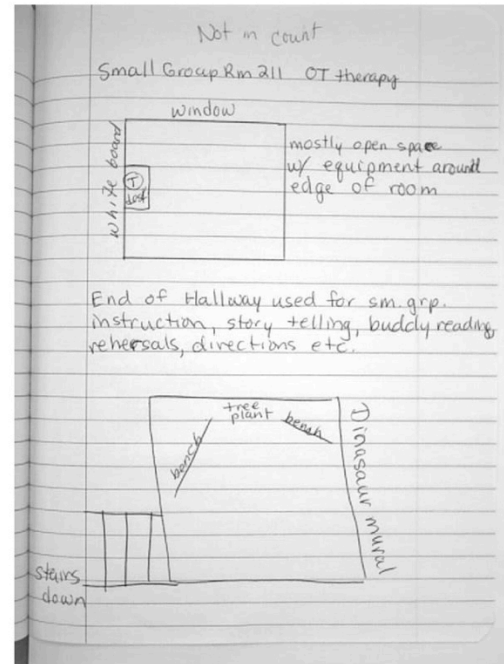
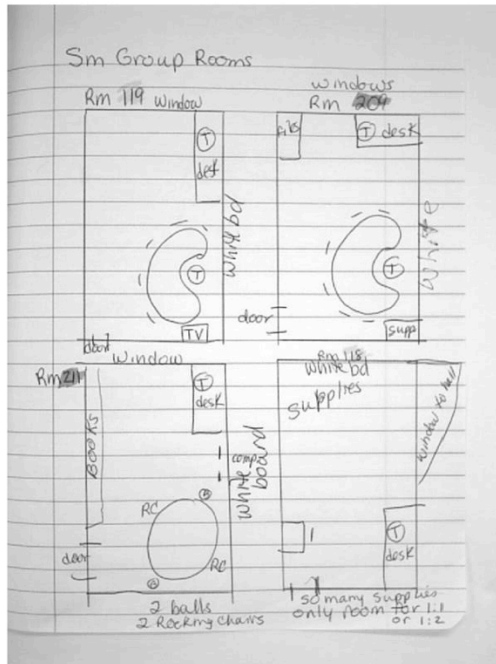


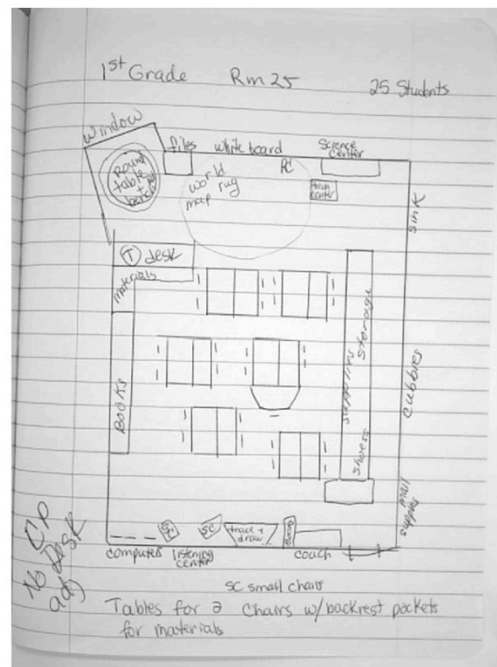
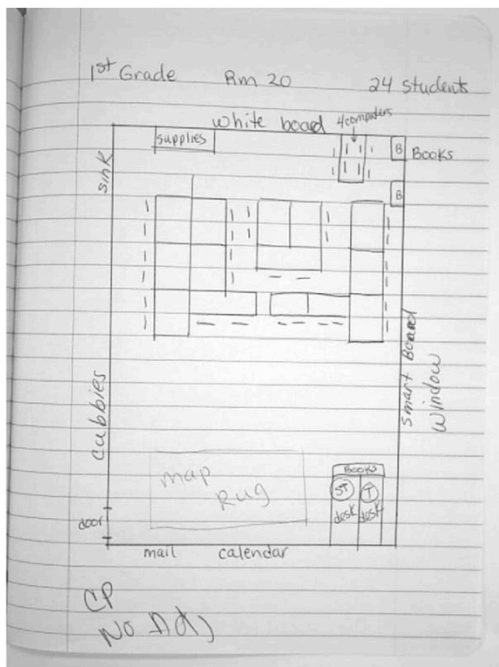
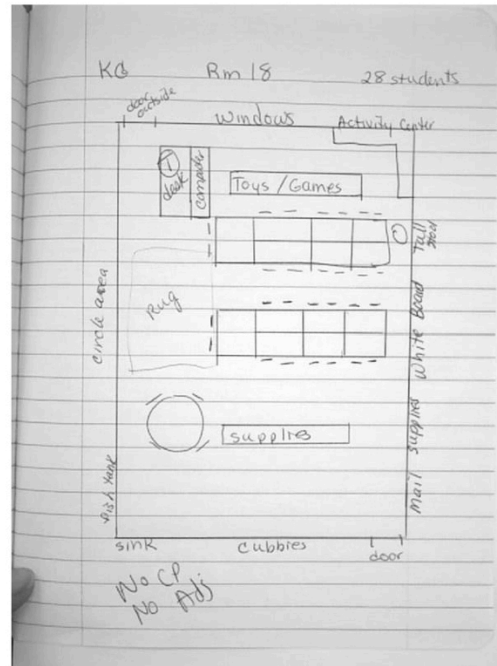
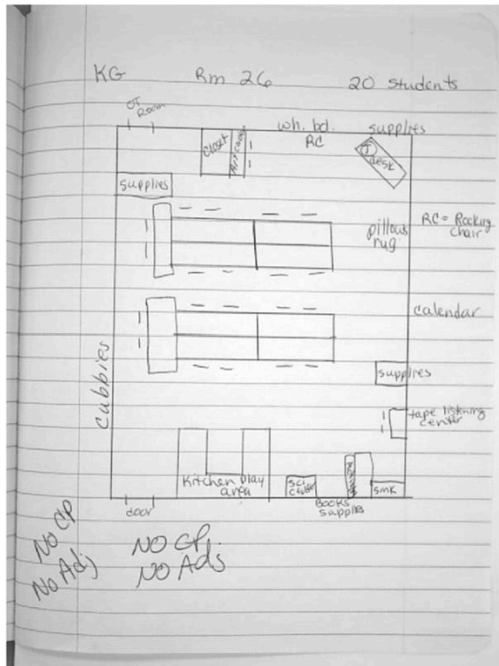


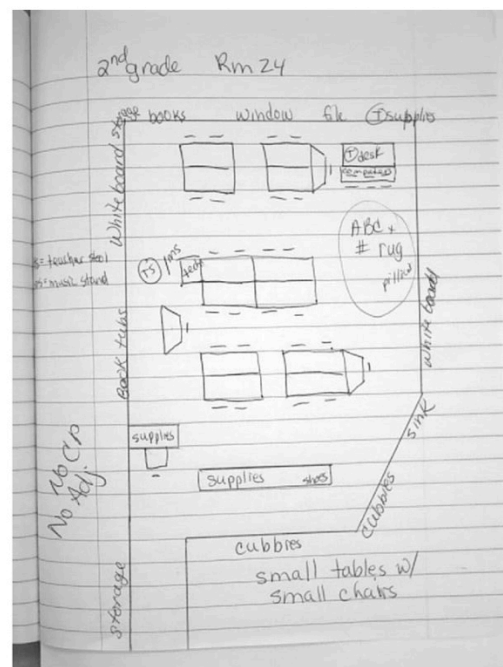
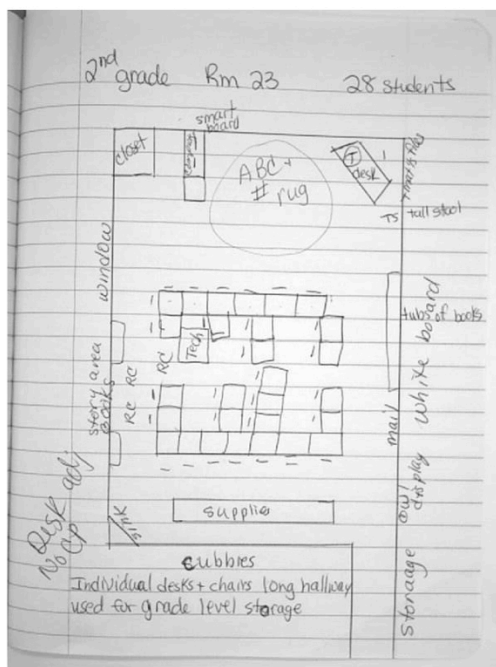
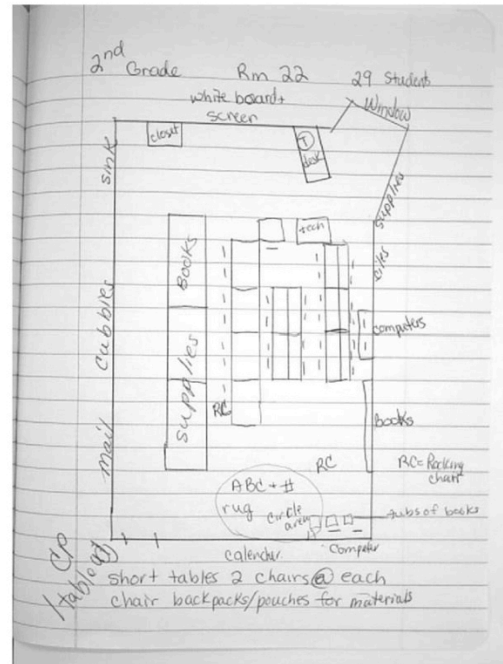
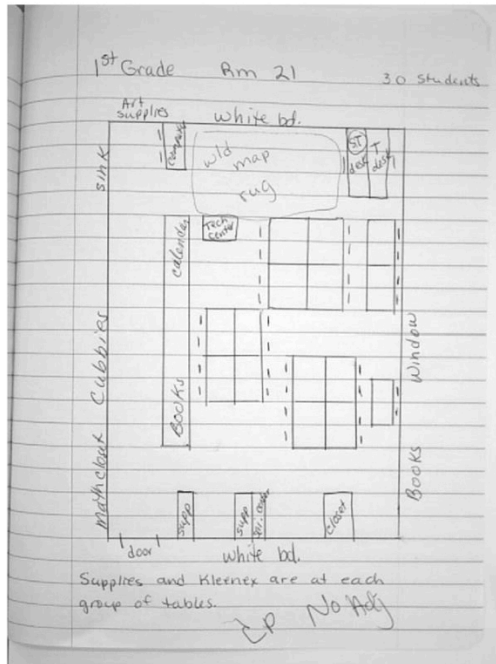


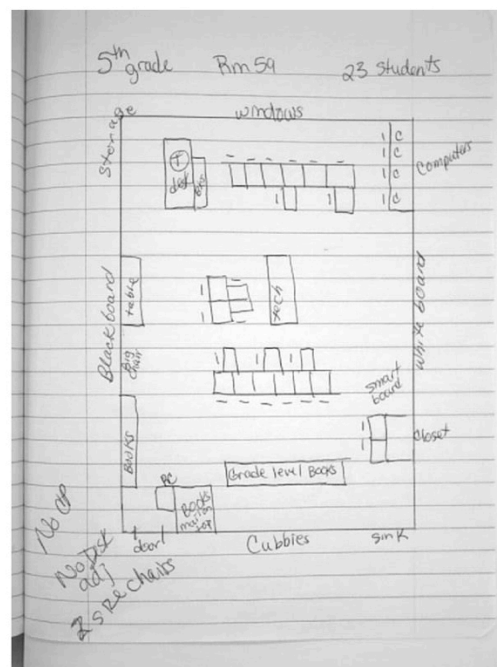
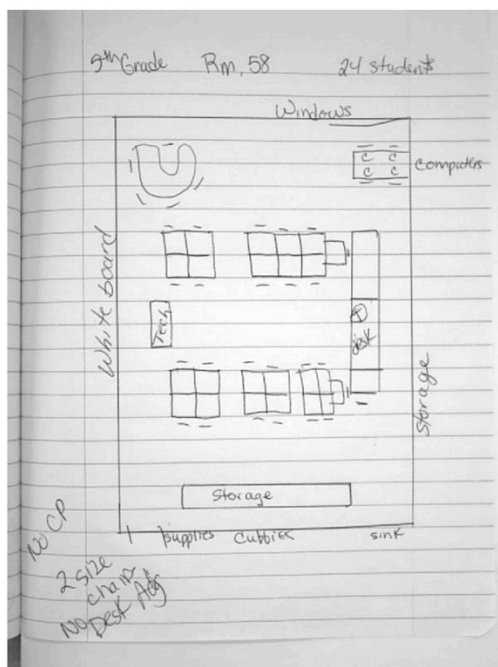
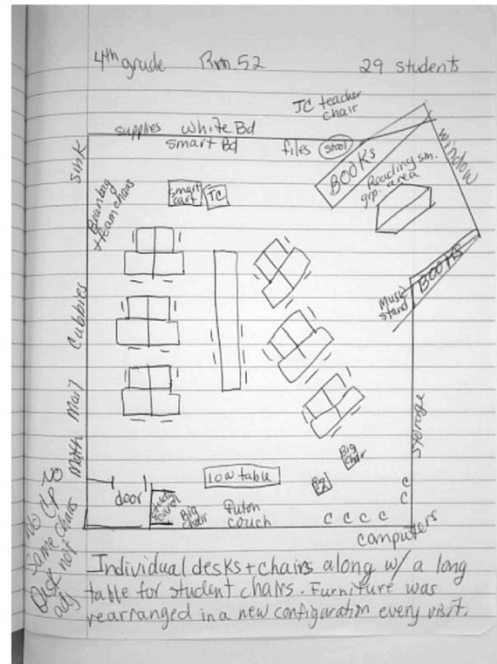
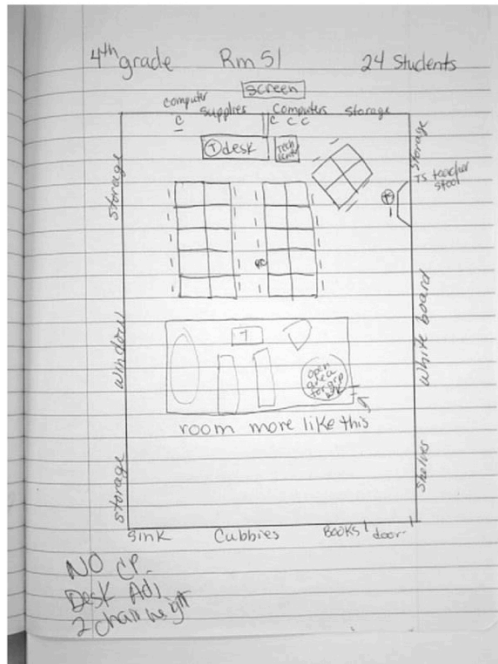


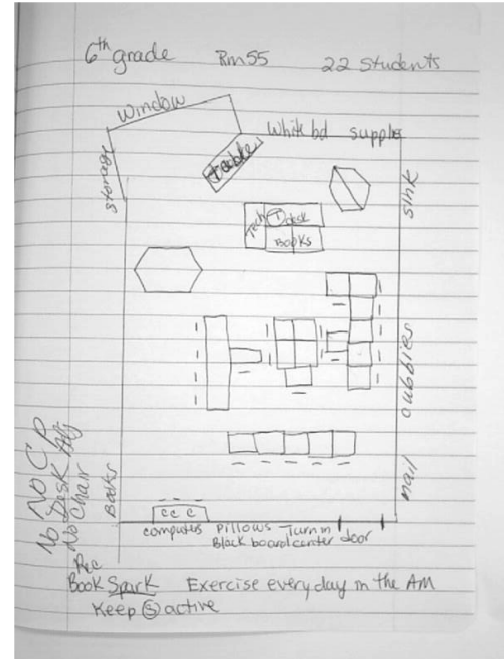
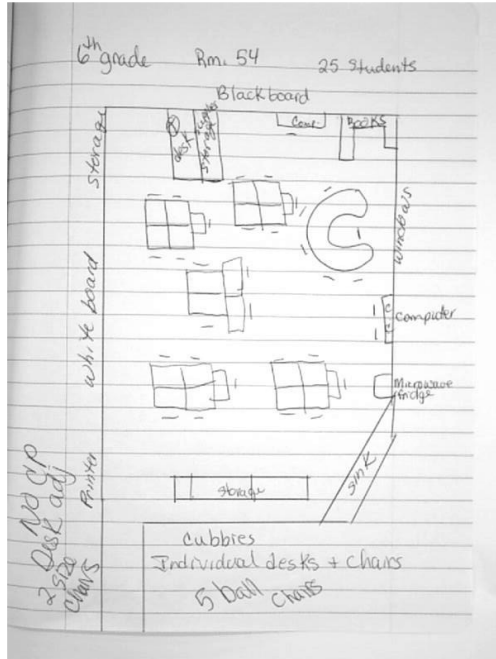
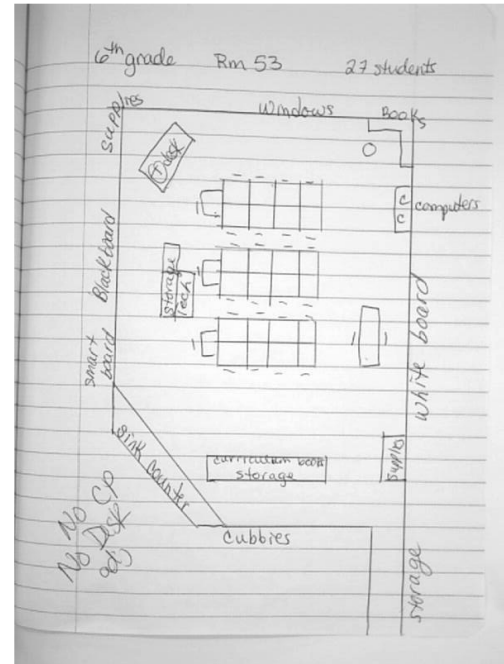
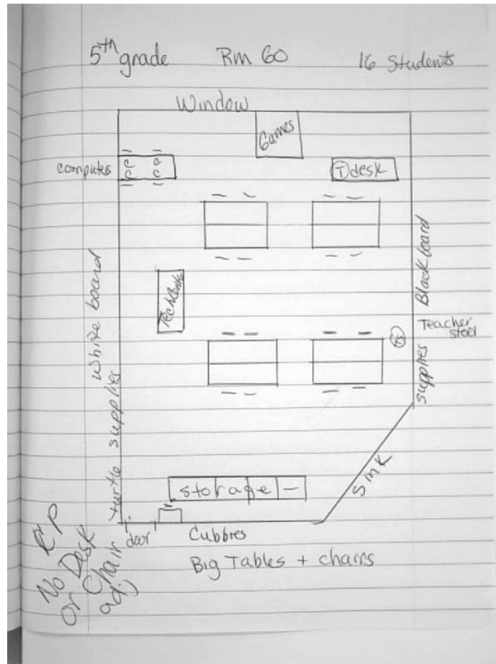


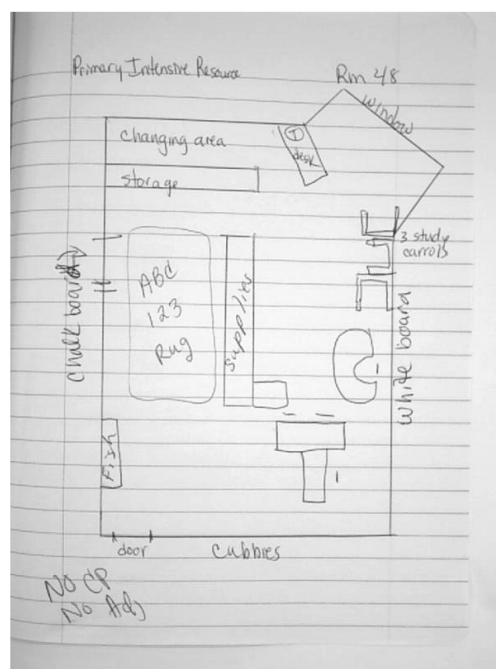
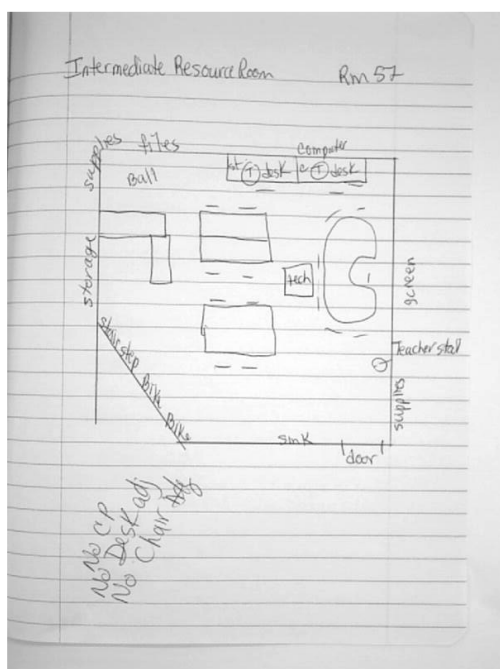
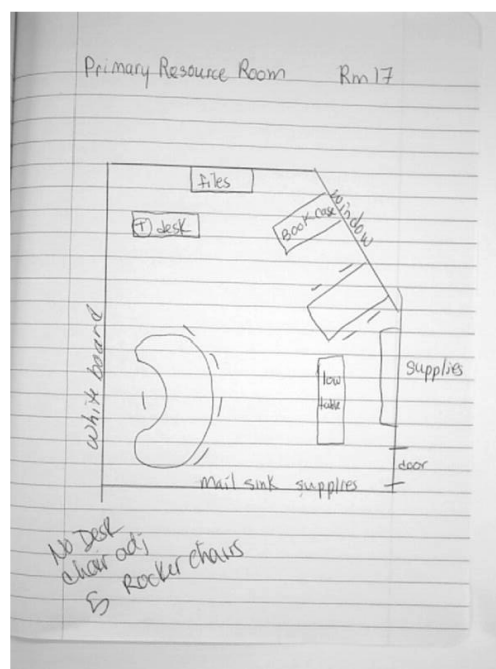
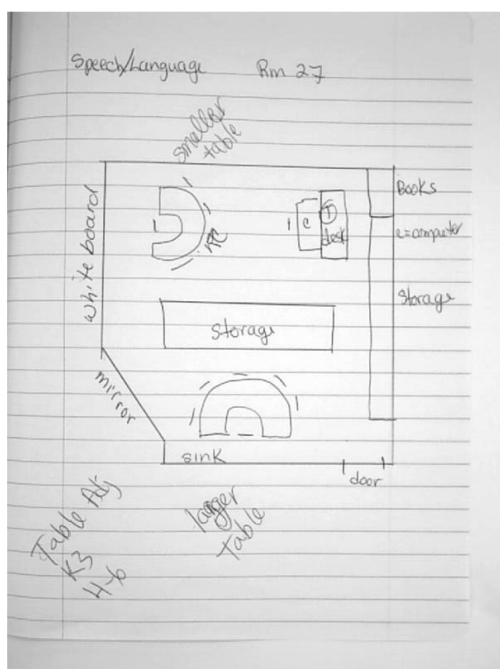


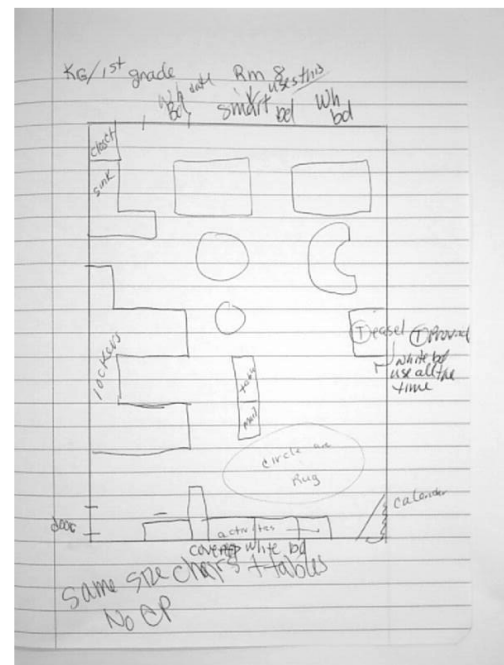
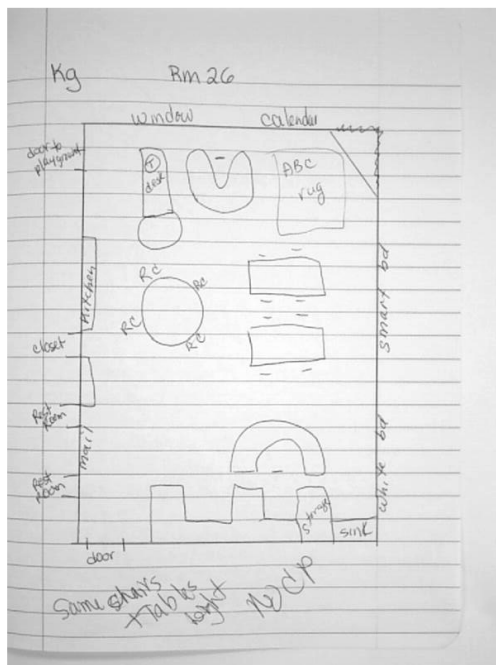
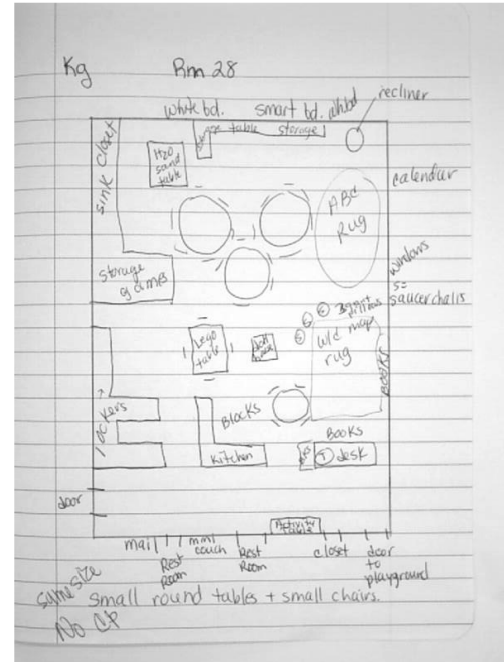
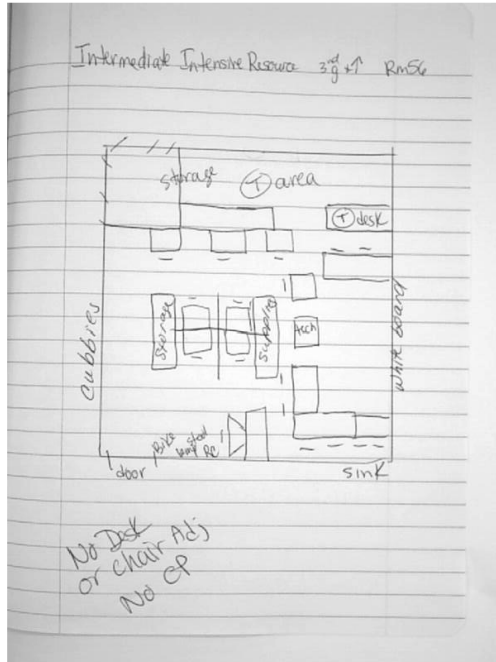


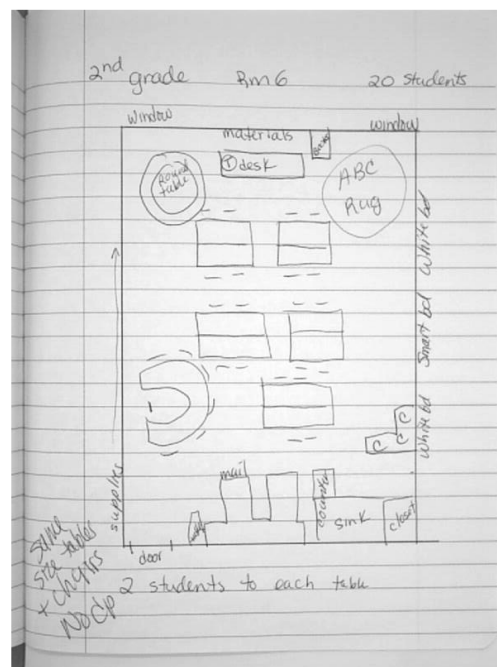
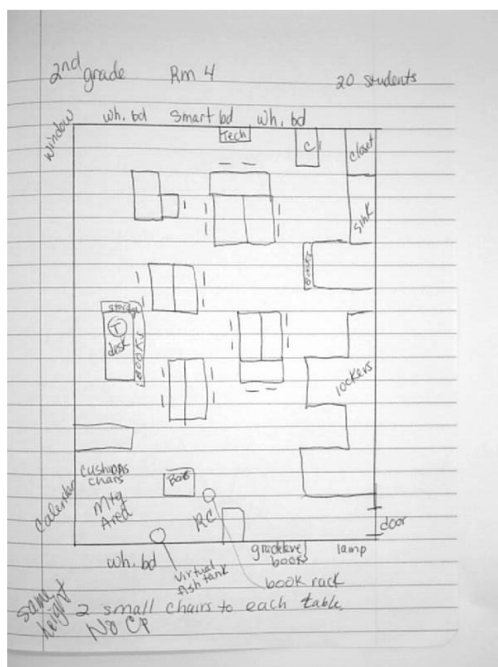
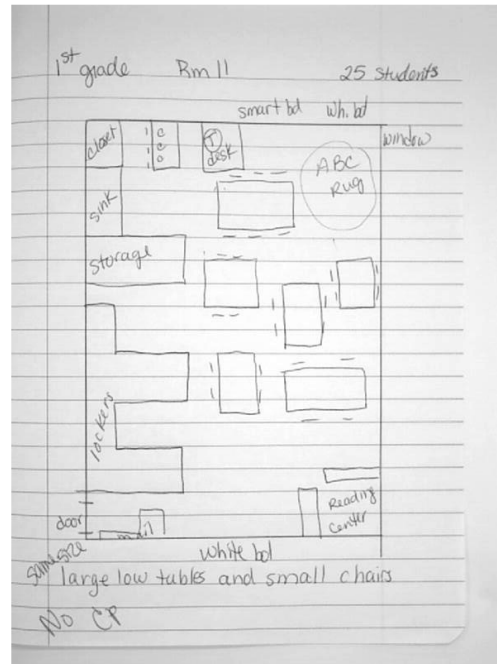
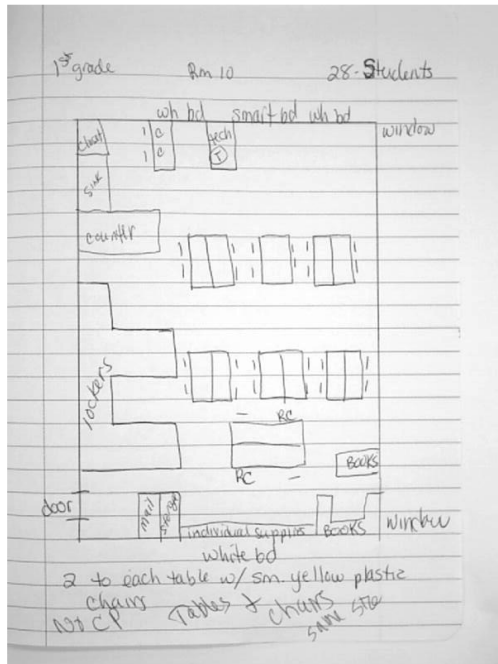


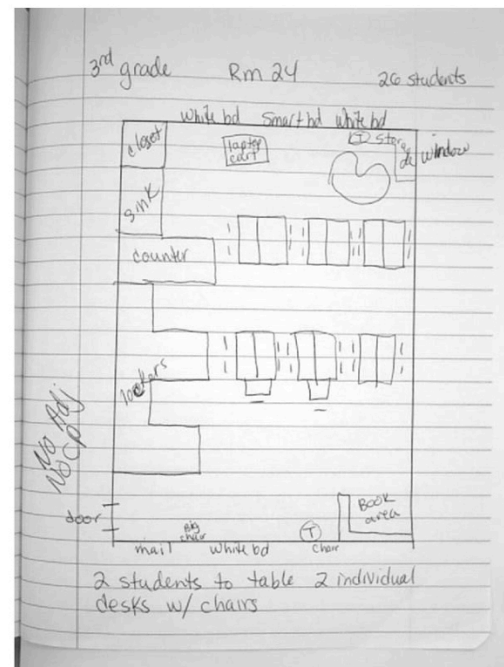
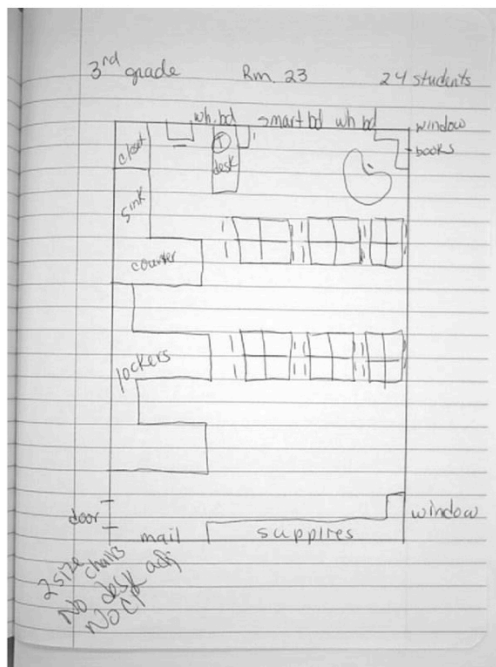
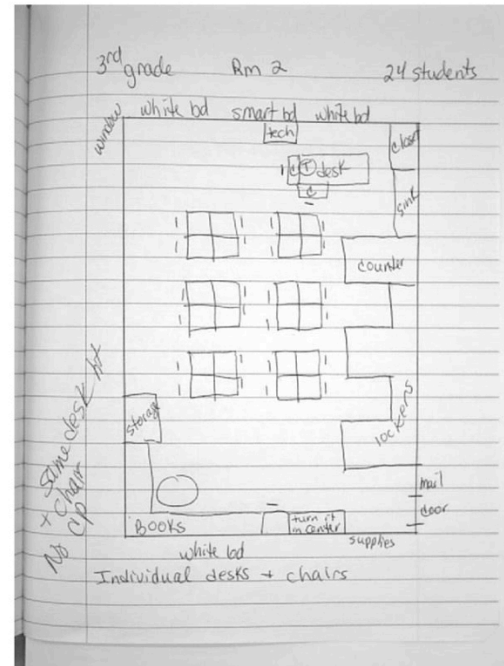
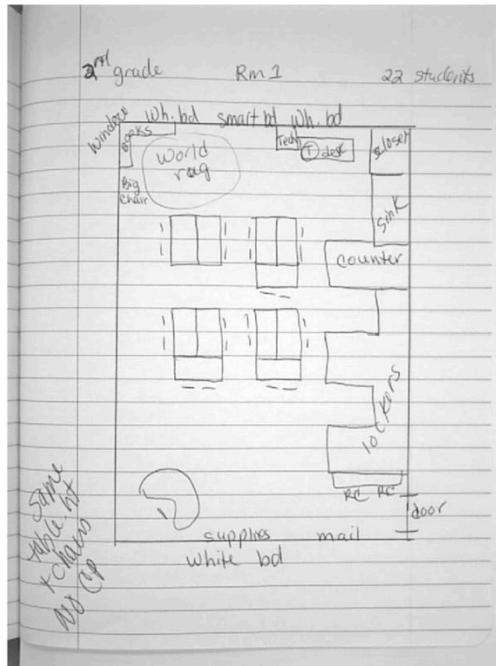


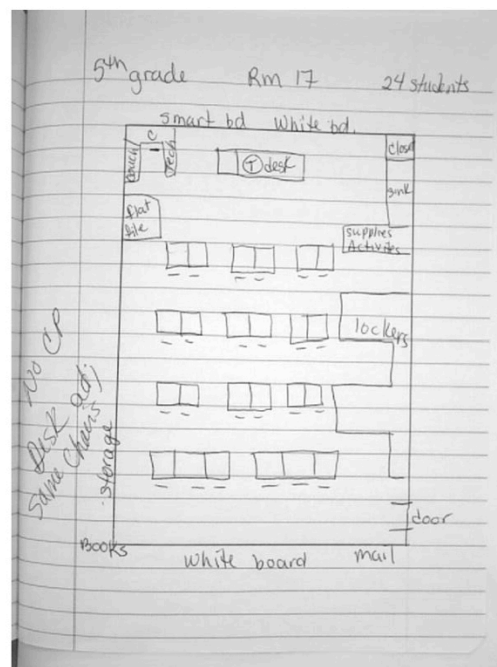
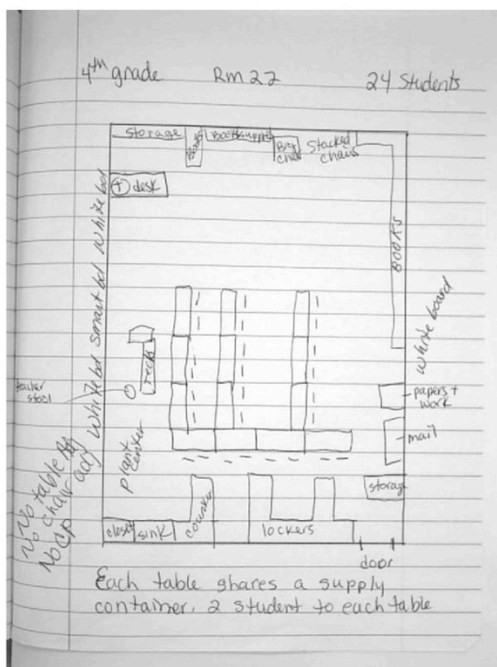
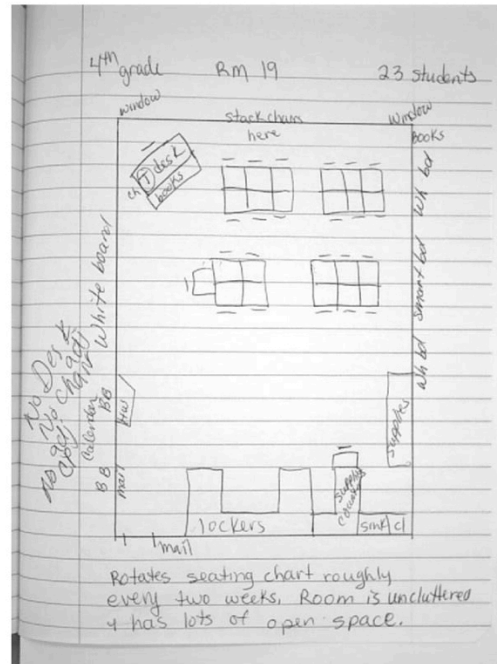
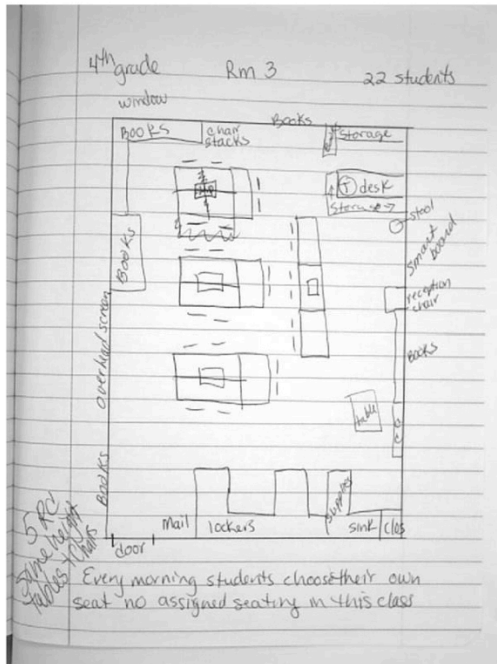


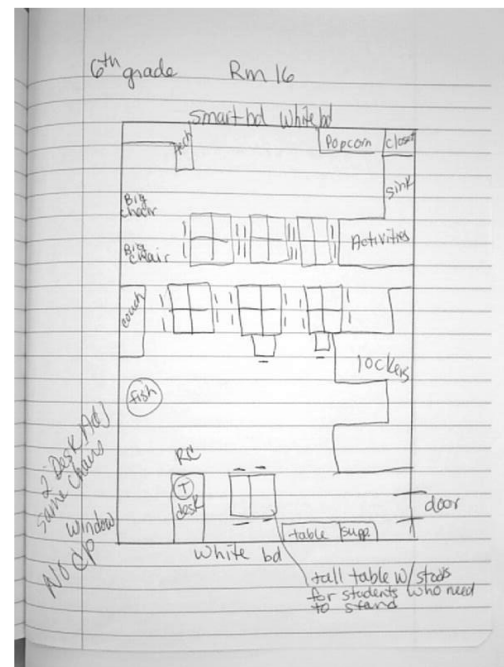
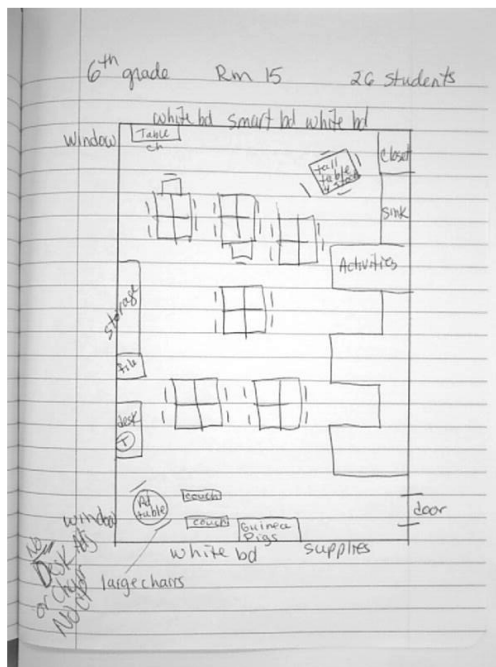
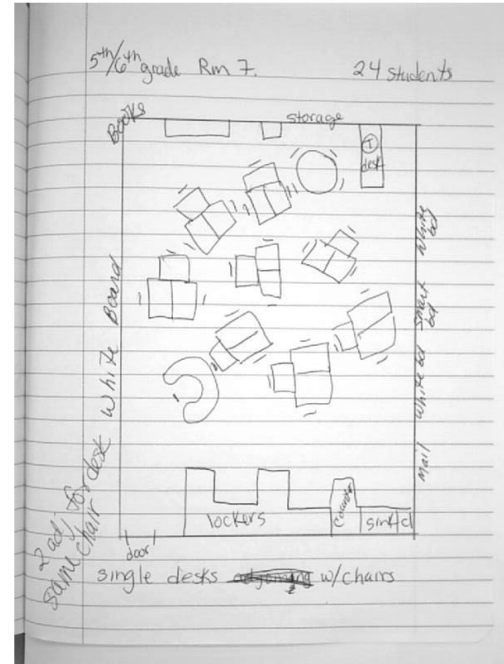
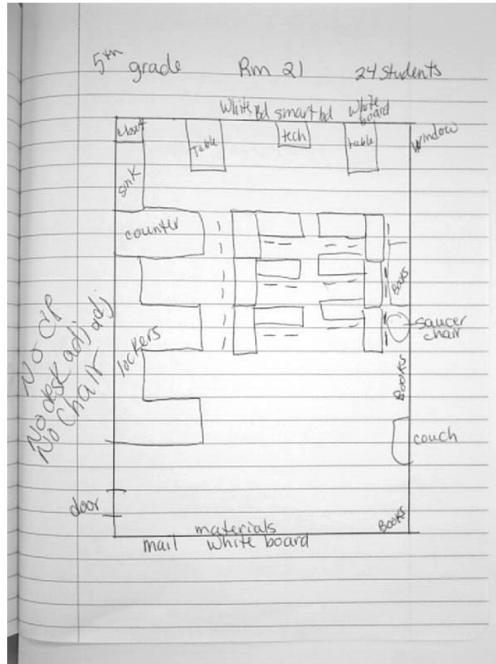


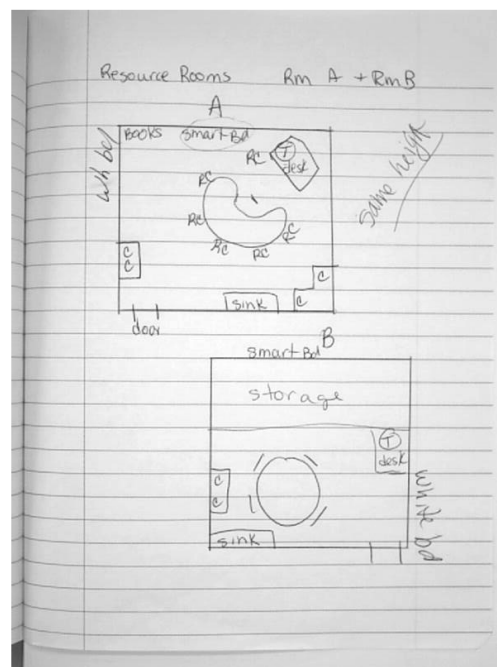
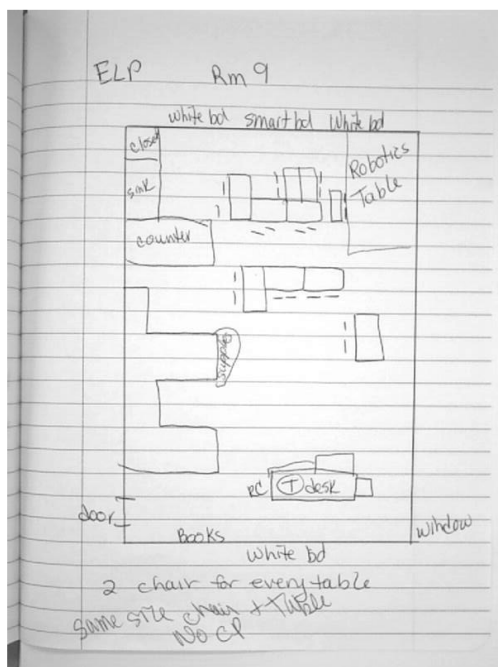
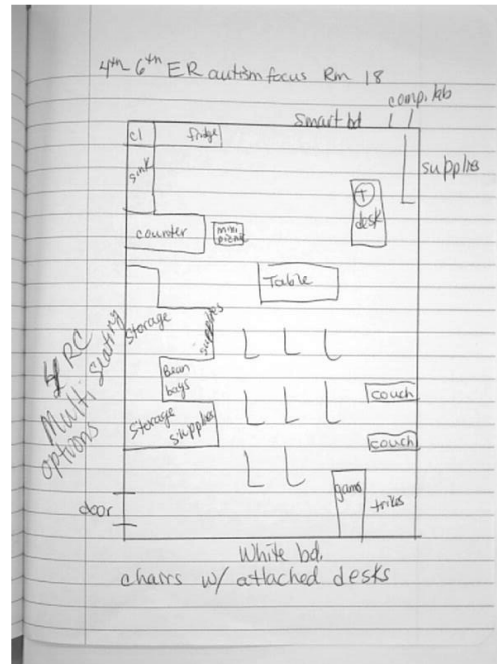
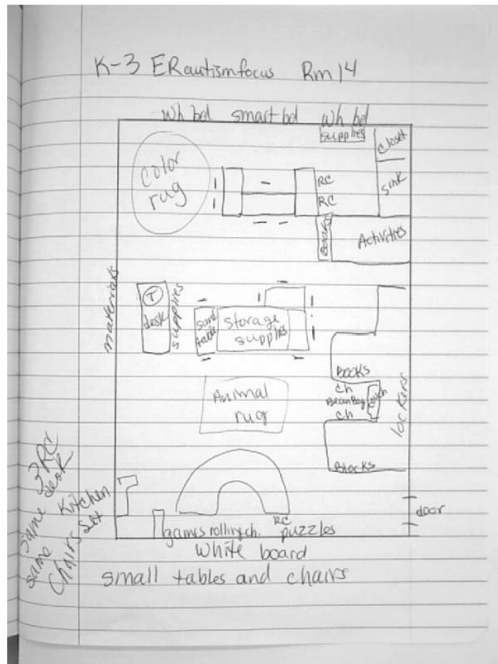












Appendix F

IRB Approval Letter Oct 12

Institutional Review Board
909 N Koyukuk Dr. Suite 212
P.O. Box 757270
Fairbanks, Alaska 99775-7270
(907) 474-7800
(907) 474-5444 fax
fyirb@uaf.edu
www.uaf.edu/irb

October 13, 2010

To: Abel Bult-Ito, Ph.D.
Principal Investigator

From: University of Alaska Fairbanks IRB
Re: [173369-5] Will postural alignment affect attention in school-aged children?

Thank you for submitting the Amendment/Modification referenced below. The submission was handled by Expedited Review under the requirements of 45 CFR 46.110, which identifies the categories of research eligible for expedited review.

Title: Will postural alignment affect attention in school-aged children?
Received: September 28, 2010
Expedited Category: 7

Action: APPROVED

Effective Date: October 12, 2010
Expiration Date: July 27, 2011

This action is included on the October 14, 2010 IRB Agenda.

No changes may be made to this project without the prior review and approval of the IRB. This includes, but is not limited to, changes in research scope, research tools, consent documents, personnel, or record storage location.

Appendix G

Posture Follow-up Questions

Posture Follow-up Questions

What have you noticed about other people's posture?

How have you changed your posture?

What changes have you noticed in the way you interact with others?

How has your ability to focus changed?

How does your posture change when you are at home, school, or in the community?

What are your thoughts about your posture being affected by people or the environment?

If you change your posture when you want to remember what people are saying, what are the changes you make to help you pay attention?

Do you have any other thoughts on the posture lessons you would like to share?

Appendix H

Parental Consent Child's Assent Paying Attention Posture Group

IRB # 173369-4

Approved for use through: 10/12/2011

Parental Consent

Child's Assent

Paying Attention

Your child is being asked to take part in a longitudinal study about paying attention. This type of study requires checking back in about one year to see if your child is still paying attention in the same way. The goal of this study is to learn if paying attention gets better over time. Your child is being asked to take part in the study because your child's school is interested in improving academic performance through increased attention. Please read this form and ask any questions you may have before you agree to your child being in this study.

If you let your child take part in this study he/she will be asked to take part in a week long posture education program for 30 minutes each day. Your child will learn about how to bend, sit, stand and walk using posture skills. Your child will be asked to either write one or two sentence summary or speak into a recorder about what they learned or any changes they have noticed after each class. This will take about 5 minutes of time. Your child will also complete a brief questionnaire/written response noting any changes they experienced at the end of the study. This will take about 5 minutes of time.

If you let your child take part in a study he/she will be asked to take an easy math test. The test is below 4th grade level and we are checking to see that he/she is paying attention to the math signs. Your child will take the test at the beginning of the study, at the end of the study, and a year later. This will take about 5 minutes of time.

Photographs and/or a video of your child may be taken at the beginning and end of the posture education class and a year later. The photos or videos will be used to take posture measurements and may be used in future papers and presentations. Covering

his/her eyes and nose with a black box will block the identity of your child in the photo or video. This will take about 2 to 3 minutes of time.

You and your child's teacher will be asked to fill out a survey about how well your child pays attention at the beginning and end of the posture education and a year later. You will also be asked to complete a brief written response noting any changes on your child.

Risks and Benefits of Being in the Study: There doesn't appear to be any risks to your child, we will let the child know that he/she may stop taking part in the study at any time.

We do not promise that your child will get any benefit from helping with this study. There will be no direct benefit to you or your child.

Confidentiality: Any information we get about your child from the study including answers to questions, math fluency tests, and photographs will be kept strictly private. Any information with your child's name attached will not be shared with anyone outside the team.

We will protect your child's privacy by coding his/her information with a number so no one can trace the answers to his/her name, and storing research records in locked cabinets in Abel Bult-Ito, the principle investigator's, office Room 307C Bunnell Building, on the University of Alaska Fairbanks campus. The data we get from this study could be used in reports, presentations, and publications but your child will not be individually identified.

Voluntary nature of the study: Your decision to allow your child to take part in the study is voluntary. Your child is free to choose not to take part in the study or stop taking part at any time without penalty. If you or your child would like to withdraw from this study use the following contacts.

Contacts and questions: If you have questions now, feel free to ask us. If you have questions later, you may contact the researcher, Joanne Healy, Assistant Professor

Special Education, (907) 474-1557 FAX: (907) 474-5451 Email: jhealy7@alaska.edu or the faculty sponsor, Abel Bult-Ito, Ph.D. Professor of Biology 1-907-474-6482 Fax: 1-907-474-6716 Email: abultito@alaska.edu

If you have any questions or concerns about your rights as a research subject, please contact the research coordinator in the office of research integrity at 474-7800 (Fairbanks area) or 1-866-876-7800 (outside the Fairbanks area) or fyirb@uaf.edu.

Statement of consent: I understand the study described above. My questions have been answered, and I agree to allow my child _____ to participate in the study. I have been given a copy of this form.

_____ My child **may** be photographed.

_____ My child **may not** be photographed.

_____ My child **may** be audio-recorded.

_____ My child **may not** be audio-recorded.

_____ My child **may** be video-recorded.

_____ My child **may not** be video-recorded.

Print Parent/Guardian Name

Signature of Parent or Guardian & Date

Statement of child's assent: I understand the study described above. My questions have been answered, and I agree to participate in the study. I have been given a copy of this form.

Print Child's Name

Signature of Child & Date

Appendix I

Parental Consent Child's Assent Paying Attention Nutrition Group

IRB # 173369-4

Approved for use through: 10/12/2011

Parental Consent

Child's Assent

Paying Attention

Your child is being asked to take part in a longitudinal study about paying attention. This type of study requires checking back in about one year to see if your child is still paying attention in the same way. The goal of this study is to learn if paying attention gets better over time. Your child is being asked to take part in the study because your child's school is interested in improving academic performance through increased attention. Please read this form and ask any questions you may have before you agree to your child being in this study.

If you let your child take part in this study he/she will be asked to take part in a 5 day nutrition education program written by the United States Dairy Association (USDA) for 30 minutes each day. Your child will learn about the new food pyramid and about healthy food choices.

If you let your child take part in a study he/she will be asked to take an easy math test. The test is below 4th grade level and we are checking to see that he/she is paying attention to the math signs. Your child will take the test at the beginning of the study, at the end of the study, and a year later. This will take about 5 minutes of time. Your child will also complete a brief questionnaire/written response noting any changes they experienced at the end of the study. This will take about 5 minutes of time.

Photographs and/or a video of your child may be taken at the beginning and end of the nutrition education class and a year later. The photos or videos will be used to take posture measurements and may be used in future papers and presentations. Covering his/her eyes and nose with a black box will block the identity of your child in the photo or video. This will take about 2 to 3 minutes of time.

You and your child's teacher will be asked to fill out a survey about how well your child pays attention at the beginning and end of the nutrition education and a year later. You will also be asked to complete a brief written response noting any changes on your child.

Risks and Benefits of Being in the Study: There doesn't appear to be any risks to your child, we will let the child know that he/she may stop taking part in the study at any time.

We do not promise that your child will get any benefit from helping with this study. There will be no direct benefit to you or your child.

Confidentiality: Any information we get about your child from the study including answers to questions, math fluency tests, and photographs will be kept strictly private. Any information with your child's name attached will not be shared with anyone outside the team.

We will protect your child's privacy by coding his/her information with a number so no one can trace the answers to his/her name, and storing research records in locked cabinets in Abel Bult-Ito, the principle investigator's, office Room 307C Bunnell Building, on the University of Alaska Fairbanks campus. The data we get from this study could be used in reports, presentations, and publications but your child will not be individually identified.

Voluntary nature of the study: Your decision to allow your child to take part in the study is voluntary. Your child is free to choose not to take part in the study or stop taking part at any time without penalty. If you or your child would like to withdraw from this study use the following contacts.

Contacts and questions: If you have questions now, feel free to ask us. If you have questions later, you may contact the researcher, Joanne Healy, Assistant Professor Special Education, (907) 474-1557 FAX: (907) 474-5451 Email: jhealy7@alaska.edu or

the faculty sponsor, Abel Bult-Ito, Ph.D. Professor of Biology 1-907-474-6482 Fax: 1-907-474-6716 Email: abultito@alaska.edu

If you have any questions or concerns about your rights as a research subject, please contact the research coordinator in the office of research integrity at 474-7800 (Fairbanks area) or 1-866-876-7800 (outside the Fairbanks area) or fyirb@uaf.edu.

Statement of consent: I understand the study described above. My questions have been answered, and I agree to allow my child _____ to participate in the study. I have been given a copy of this form.

_____ My child **may** be photographed.

_____ My child **may not** be photographed.

_____ My child **may** be audio-recorded.

_____ My child **may not** be audio-recorded.

_____ My child **may** be video-recorded.

_____ My child **may not** be video-recorded.

Print Parent/Guardian Name

Signature of Parent or Guardian & Date

Statement of child's assent: I understand the study described above. My questions have been answered, and I agree to participate in the study. I have been given a copy of this form.

Print Child's Name

Signature of Child & Date

Appendix J

Teacher Consent Paying Attention

IRB # 173369-4

Approved for use through: 7/27/2011

Teacher Consent

Paying Attention

You are being asked to take part in a longitudinal study about paying attention. This type of study requires checking back in about one year to see if your students are still paying attention in the same way. The goal of this study is to learn if paying attention gets better over time. You are being asked to take part in the study because your school is interested in improving academic performance through increased attention. Please read this form and ask any questions you may have before you agree to being in this study.

You will be asked to fill out a survey about how well your students pay attention at the beginning and end of the study and a year later. You will also be asked to complete a questionnaire/brief written response noting any changes in your students. You will rate the impact of instruction on the classroom using a rating scale and may document what you do to remind students of the importance of correct postural alignment.

Risks and Benefits of Being in the Study: There doesn't appear to be any risks to you. There will be no direct benefit to you.

Confidentiality: Any information we get about you from the study including answers to questions will be kept strictly private. Any information with your name attached will not be shared with anyone outside the team.

We will protect your privacy by coding information with a number so no one can trace the answers to your name, and storing research records in locked cabinets in Abel Bult-Ito, the principle investigator's, office Room 307C Bunnell Building, on the University of Alaska Fairbanks campus. The data we get from this study could be used in reports, presentations, and publications but you will not be individually identified.

Voluntary nature of the study: Your decision to take part in the study is voluntary. You are free to choose not to take part in the study or stop taking part at any time without penalty. If you would like to withdraw from this study use the following contacts.

Contacts and questions: If you have questions now, feel free to ask us. If you have questions later, you may contact the researcher, Joanne Healy, Assistant Professor Special Education, (907) 474-1557 FAX: (907) 474-5451 Email: jhealy7@alaska.edu or the faculty sponsor, Abel Bult-Ito, Ph.D. Professor of Biology 1-907-474-6482 Fax: 1-907-474-6716 Email: abultito@alaska.edu

If you have any questions or concerns about your rights as a research subject, please contact the research coordinator in the office of research integrity at 474-7800 (Fairbanks area) or 1-866-876-7800 (outside the Fairbanks area) or fyirb@uaf.edu.

Statement of Teacher consent: I understand the study described above. My questions have been answered, and I agree to participate in the study. I have been given a copy of this form.

_____ Print Teacher Name
_____ Signature of Teacher & Date

Appendix K

Partial Vanderbilt ADHD Diagnostic Parent Rating Scale

Partial Vanderbilt ADHD Diagnostic Parent Rating Scale

Instructions and Scoring

Behaviors are counted if they are scored 2 (often) or 3 (very often)

Inattention Requires six or more counted behaviors from questions 1 – 9
for indication of the predominantly inattentive subtype

Hyperactivity/ Requires six or more counted behaviors from questions 10 –

Impulsivity 18 for indication of the predominantly hyperactive/impulsive
subtype

Combined Requires six or more counted behaviors each on both the
subtype inattention and hyperactivity/impulsivity dimensions

The performance section is scored as indicating some impairment if a child scores 1 or 2 on at least one item.

FOR MORE INFORMATION CONTACT

Mark Wolraich, M.D.

Shaun Walters Endowed Professor of Developmental and Behavioral Pediatrics

Oklahoma University Health Sciences Center

1100 Northeast 13th Street

Oklahoma City, OK 73117

Phone: (405) 271-6824, ext. 123

E-mail: mark-wolraich@ouhsc.edu

The scale is available at http://peds.mc.vanderbilt.edu/VCHWEB_1/rating~1.html.

REFERENCE FOR THE SCALE'S PSYCHOMETRIC PROPERTIES

Wolraich ML, Feurer ID, Hannah JN, et al. 1998.

Obtaining systematic teacher reports of disruptive behavior disorders utilizing DSM-IV.

Journal of

Abnormal Child Psychology 26(2):141–152.

Vanderbilt ADHD Diagnostic Parent Rating Scale

Name: _____ Today's Date _____

Date of Birth _____ Age _____ Grade _____

Each rating should be considered in the context of what is appropriate for the age of the children you are rating.

Frequency Code: 0 = Never; 1 = Occasionally; 2 = Often; 3 = Very Often

1. Does not pay attention to details or makes careless mistakes, such as in homework	0	1	2	3
2. Has difficulty sustaining attention to tasks or activities	0	1	2	3
3. Does not seem to listen when spoken to directly	0	1	2	3
4. Does not follow through on instruction and fails to finish schoolwork (not due to oppositional behavior or failure to understand)	0	1	2	3
5. Has difficulty organizing tasks and activities	0	1	2	3
6. Avoids, dislikes, or is reluctant to engage in tasks that require sustaining mental effort	0	1	2	3
7. Loses things necessary for tasks or activities (school assignments, pencils, or books)	0	1	2	3

8. Is easily distracted by extraneous stimuli	0	1	2	3
9. Is forgetful in daily activities	0	1	2	3
10. Fidgets with hands or feet or squirms in seat	0	1	2	3
11. Leaves seat when remaining seated is expected	0	1	2	3
12. Runs about or climbs excessively in situations in which remaining seated is expected	0	1	2	3
13. Has difficulty playing or engaging in leisure activities quietly	0	1	2	3

14. Is “on the go” or often acts as if “driven by a motor”	0	1	2	3
15. Talks too much	0	1	2	3
16. Blurts out answers before questions have been completed	0	1	2	3
17. Has difficulty waiting in line	0	1	2	3
18. Interrupts or intrudes on others (e.g., butts into conversations or games)	0	1	2	3

Performance

Academic Performance

	Problematic		Average	Above Average	
1. Reading	1	2	3	4	5
2. Mathematics	1	2	3	4	5
3. Written Expression	1	2	3	4	5

Classroom Behavior

	Problematic	Average		Above Average	
1. Relationships with Peers	1	2	3	4	5
2. Following Directions/Rules	1	2	3	4	5
3. Disrupting Class	1	2	3	4	5
4. Assignment completion	1	2	3	4	5
5. Organizational skills	1	2	3	4	5

Appendix L

Partial Vanderbilt ADHD Diagnostic Teacher Rating Scale

Partial Vanderbilt ADHD Diagnostic Teacher Rating Scale

Instructions and Scoring

Behaviors are counted if they are scored 2 (often) or 3 (very often)

Inattention	Requires six or more counted behaviors from questions 1 – 9 for indication of the predominantly inattentive subtype
Hyperactivity/	Requires six or more counted behaviors from questions 10 –
Impulsivity	18 for indication of the predominantly hyperactive/impulsive subtype
Combined	Requires six or more counted behaviors each on both the subtype inattention and hyperactivity/impulsivity dimensions

The performance section is scored as indicating some impairment if a child scores 1 or 2 on at least one item.

FOR MORE INFORMATION CONTACT

Mark Wolraich, M.D.

Shaun Walters Endowed Professor of Developmental and Behavioral Pediatrics

Oklahoma University Health Sciences Center

1100 Northeast 13th Street

Oklahoma City, OK 73117

Phone: (405) 271-6824, ext. 123

E-mail: mark-wolraich@ouhsc.edu

The scale is available at [http://peds.mc.](http://peds.mc.vanderbilt.edu/VCHWEB_1/rating~1.html)

[vanderbilt.edu/VCHWEB_1/rating~1.html](http://peds.mc.vanderbilt.edu/VCHWEB_1/rating~1.html).

REFERENCE FOR THE SCALE'S PSYCHOMETRIC PROPERTIES

Wolraich ML, Feurer ID, Hannah JN, et al. 1998.

Obtaining systematic teacher reports of disruptive behavior disorders utilizing DSM-IV.

Journal of

Abnormal Child Psychology 26(2):141–152.

Vanderbilt ADHD Diagnostic Teacher Rating Scale

Name: _____ Grade: _____ Date of Birth: _____

Teacher: _____ School: _____

Each rating should be considered in the context of what is appropriate for the age of the children you are rating.

Frequency Code: 0 = Never; 1 = Occasionally; 2 = Often; 3 = Very Often

1. Fails to give attention to details or makes careless mistakes in schoolwork.	0	1	2	3
2. Has difficulty sustaining attention to tasks or activities	0	1	2	3
3. Does not seem to listen when spoken to directly	0	1	2	3
4. Does not follow through on instruction and fails to finish schoolwork (not due to oppositional behavior or failure to understand)	0	1	2	3
5. Has difficulty organizing tasks and activities	0	1	2	3
6. Avoids, dislikes, or is reluctant to engage in tasks that require sustaining mental effort	0	1	2	3
7. Loses things necessary for tasks or activities (school				

assignments, pencils, or books)	0	1	2	3
8. Is easily distracted by extraneous stimuli	0	1	2	3
9. Is forgetful in daily activities	0	1	2	3
10. Fidgets with hands or feet or squirms in seat	0	1	2	3
11. Leaves seat in classroom or in other situations in which remaining seated is expected	0	1	2	3
12. Runs about or climbs excessively in situations in which remaining seated is expected	0	1	2	3
13. Has difficulty playing or engaging in leisure activities quietly	0	1	2	3
14. Is “on the go” or often acts as if “driven by a motor”	0	1	2	3
15. Talks excessively	0	1	2	3
16. Blurts out answers before questions have been completed	0	1	2	3
17. Has difficulty waiting in line	0	1	2	3
18. Interrupts or intrudes on others (e.g., butts into conversations or games).	0	1	2	3

Performance**Academic Performance**

	Problematic		Average	Above Average	
1. Reading	1	2	3	4	5
2. Mathematics	1	2	3	4	5
3. Written Expression	1	2	3	4	5

Classroom Behavior

	Problematic		Average	Above Average	
1. Relationships with Peers	1	2	3	4	5
2. Following Directions/Rules	1	2	3	4	5
3. Disrupting Class	1	2	3	4	5
4. Assignment completion	1	2	3	4	5
5. Organizational skills	1	2	3	4	5

Appendix M
Math Fluency Assessment

2	3	1	1	1	2	0	0	3	4
<u>-1</u>	<u>+0</u>	<u>+1</u>	<u>+4</u>	<u>-1</u>	<u>-2</u>	<u>-0</u>	<u>+1</u>	<u>-2</u>	<u>-2</u>

6	3	5	2	3	3	3	5	6	6
<u>+0</u>	<u>+1</u>	<u>+1</u>	<u>+2</u>	<u>-0</u>	<u>+3</u>	<u>+4</u>	<u>-3</u>	<u>-1</u>	<u>-3</u>

7	2	7	3	6	3	1	5	5	4
<u>-1</u>	<u>+3</u>	<u>-4</u>	<u>-3</u>	<u>+1</u>	<u>-1</u>	<u>+7</u>	<u>-4</u>	<u>+2</u>	<u>+4</u>

3	5	5	10	8	6	7	2	9	9
<u>+5</u>	<u>-2</u>	<u>+5</u>	<u>-3</u>	<u>-1</u>	<u>-2</u>	<u>-2</u>	<u>+8</u>	<u>+1</u>	<u>-3</u>

6	3	9	7	6	8	4	5	7	4
<u>+2</u>	<u>+6</u>	<u>+3</u>	<u>-6</u>	<u>+5</u>	<u>-3</u>	<u>+6</u>	<u>+4</u>	<u>-7</u>	<u>+7</u>

7	8	5	8	7	1	10	8	6	9
<u>+2</u>	<u>-5</u>	<u>-3</u>	<u>+0</u>	<u>-5</u>	<u>+8</u>	<u>-7</u>	<u>+5</u>	<u>+8</u>	<u>-7</u>

5	8	6	3	10	1	9	7	9	2
<u>x 1</u>	<u>+4</u>	<u>-5</u>	<u>x 3</u>	<u>-5</u>	<u>x 3</u>	<u>-2</u>	<u>+5</u>	<u>+8</u>	<u>x 1</u>

7	1	9	6	3	4	3	8	2	9
<u>+3</u>	<u>x 1</u>	<u>-6</u>	<u>+6</u>	<u>x 2</u>	<u>+2</u>	<u>x 3</u>	<u>-8</u>	<u>x 2</u>	<u>+5</u>

7	7	8	8	1	7	9	5	3	10
<u>x 1</u>	<u>-0</u>	<u>x 5</u>	<u>-2</u>	<u>x 0</u>	<u>+4</u>	<u>x 3</u>	<u>-5</u>	<u>x 5</u>	<u>-1</u>

$$\begin{array}{r} \text{\scriptsize 4} \\ -0 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 7} \\ \times 3 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 7} \\ +6 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 6} \\ \times 7 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 8} \\ -5 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 7} \\ \times 7 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 10} \\ -9 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 3} \\ \times 8 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 10} \\ -4 \\ \hline \end{array} \quad \begin{array}{r} \text{\scriptsize 9} \\ \times 6 \\ \hline \end{array}$$

[illegible]

$$\begin{array}{r} 3 6 9 4 8 0 9 4 10 5 \\ +8 -4 \times 9 \times 7 +8 \times 6 -1 \times 4 -3 \times 6 \end{array}$$

$$\begin{array}{r} 7 \\ \underline{-6} \end{array} \quad \begin{array}{r} 4 \\ \underline{\times 9} \end{array} \quad \begin{array}{r} 10 \\ \underline{-0} \end{array} \quad \begin{array}{r} 8 \\ \underline{\times 6} \end{array} \quad \begin{array}{r} 9 \\ \underline{+7} \end{array} \quad \begin{array}{r} 8 \\ \underline{\times 9} \end{array} \quad \begin{array}{r} 8 \\ \underline{\times 8} \end{array} \quad \begin{array}{r} 6 \\ \underline{+5} \end{array} \quad \begin{array}{r} 5 \\ \underline{\times 5} \end{array} \quad \begin{array}{r} 8 \\ \underline{-7} \end{array}$$

$$\begin{array}{r} 5 9 6 8 9 9 5 4 0 7 \\ \underline{x 4} \quad \underline{- 5} \quad \underline{x 3} \quad \underline{x 0} \quad \underline{x 2} \quad \underline{+ 6} \quad \underline{x 7} \quad \underline{x 6} \quad \underline{x 4} \quad \underline{- 1} \end{array}$$

$$\begin{array}{r} 2 8 6 7 9 6 0 8 4 10 \\ \underline{x7} \quad \underline{-4} \quad \underline{x6} \quad \underline{-3} \quad \underline{-7} \quad \underline{x1} \quad \underline{x3} \quad \underline{+5} \quad \underline{x8} \quad \underline{-7} \end{array}$$

Appendix N
Nutrition Pre and Post Test

Pre- and Post-Test

Arianna's Nutrition Expedition™

Name: _____ Date: _____

1. What can you do to keep yourself healthy?

2. How do you think nutrition plays a role in keeping your body healthy?

3. Have you ever heard of the Food Groups?
(CIRCLE ONE ANSWER ONLY)

Yes

No

4. How many Food Groups are there? Write the number below.

5. What do you need to eat every day to be healthy?
(CIRCLE ONE ANSWER ONLY)

Eat foods from two different Food Groups every day.

Eat foods from five different Food Groups every day.

Eat foods from seven different Food Groups every day.

6. Which of these foods are in the Milk Group?
(CIRCLE AS MANY ANSWERS AS YOU NEED)

Yogurt Corn Cheese Eggs Cereal

7. Which of these foods are in the Fruit Group?
(CIRCLE AS MANY ANSWERS AS YOU NEED)

Peanut butter Apple Green beans Grapes Banana

8. Which of these foods are in the Meat Group?
(CIRCLE AS MANY ANSWERS AS YOU NEED)

Peanut butter Milk Hamburger Corn Chicken

9. Which of these foods are in the Vegetable Group?
(CIRCLE AS MANY ANSWERS AS YOU NEED)

Orange Carrots Peanuts Corn Noodles

10. Which of these foods are in the Grain Group?
(CIRCLE AS MANY ANSWERS AS YOU NEED)

Bread Milk Hamburger Cereal Eggs

11. Circle the one food that best helps build strong bones and teeth.
(CIRCLE ONLY ONE ANSWER)

Bread Chicken Carrot Milk Apple

12. Circle the one food that best helps build strong muscles.
(CIRCLE ONLY ONE ANSWER)

Cereal Chicken Carrot Yogurt Orange

13. Circle the one food that best helps you see in the dark.

(CIRCLE ONLY ONE ANSWER)

Bread Eggs Green beans Milk Orange

14. Circle the one food that best helps give you energy.

(CIRCLE ONLY ONE ANSWER)

Bread Peanuts Carrot Cheese Orange

15. Circle the one food that best helps your body to heal cuts.

(CIRCLE ONLY ONE ANSWER)

Noodles Eggs Corn Milk Orange

16. Think about how nutrients work in your body. Match each Food Group on the left to the nutrient it gives from the list on the right. Write the letter in the space next to the Food Group.

_____ Grain Group
_____ Vegetable Group
_____ Fruit Group
_____ Milk Group
_____ Meat Group

A. Calcium
B. Protein
C. Vitamin A
D. Vitamin C
E. Carbohydrate

17. How many servings of each Food Group do you need each day to be healthy?
Write the number in the space next to the Food Group.

Grain Group: _____ servings

Vegetable Group: _____ servings

Fruit Group: _____ servings

Milk Group: _____ servings

Meat Group: _____ servings

18. Let's pretend that your mother asks you what you want for lunch today. Which foods and drinks would you choose for a healthy, nutritious lunch?
(WRITE ANSWER ON SPACES BELOW)

19. Please name two Combination Foods and write down what foods and food groups are in each one.

A. **Combination Food 1:** _____

B. Foods and Food Groups in it: _____

A. **Combination Food 2:** _____

B. Foods and Food Groups in it: _____

20. Why are Combination Foods good for you?
(CIRCLE ONLY ONE ANSWER)

- A. They provide nutrients from more than one food group.
- B. They help you get your recommended number of servings from the Five Food Groups.
- C. They provide more health benefits.
- D. All of the above

21. Below is a menu for someone your age who likes all different kinds of food. It includes all meals plus a snack for one day.

Breakfast	Lunch	Snacks	Supper
Cereal	Roll	½ Bagel	Chicken
Toast (1 slice)	Yogurt	Carrot sticks	Rice
Strawberries	Apple	Cheese	Green Beans
Milk			Salad (with lettuce and tomato)

Determine if this menu has enough Food Group foods in it for a 6-5-3-3-2 diet.

Please use the following Food Group Chart to help you count the foods in the food groups. List each food from the menu above in its correct food group below. After you have listed all foods, please answer the question below.

Grain Group	Vegetable Group	Fruit Group	Milk Group	Meat Group
Total				

What foods, if any, would you add to make this a 6-5-3-3-2 diet?

(CIRCLE ONLY ONE ANSWER)

- A. Pear with cheese and crackers
B. ½ peanut butter sandwich with celery and grapes
C. Orange and roast beef with cucumber
D. Nothing

Appendix O

Post Student Survey Postural Alignment Group

1. The five days of 30 minutes of posture instruction was helpful.

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. The reminder message like “sit tall” played every 20-minutes was helpful.

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. This posture instruction made it easier to pay attention.

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. This posture instruction made it easier to complete tasks.

Strongly Agree Agree Neutral Disagree Strongly Disagree

5. This posture instruction made it easier to sit strong.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Comments: I really liked ...because

I didn't like ... because

Appendix P

Post Teacher Survey Impact of Postural Alignment Instruction

1. The initial five days of 30 minutes of instruction was beneficial.

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. The reminder messages like “sit strong” played every 20-minutes was helpful.

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. Filling out the pre and post Vanderbilt ADHD Diagnostic Teacher Rating Scale and the post brief written summary of any noted changes on each student was helpful.

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. This intervention made a positive impact on my students’ ability to pay attention.

Strongly Agree Agree Neutral Disagree Strongly Disagree

5. This intervention made a positive impact on my students’ ability to complete tasks.

Strongly Agree Agree Neutral Disagree Strongly Disagree

6. This intervention made a positive impact on my students’ postural alignment.

Strongly Agree Agree Neutral Disagree Strongly Disagree

Comments: _____

Appendix Q

Exit Slip

Exit Slip:

What did you learn today?

Why do you think this is important?

What questions do you have? What else do you want to know?

Appendix R
Classroom Furniture



Standard Seating



Stacked Chairs



Rocker Chair

Appendix S

ADHD, Math Fluency, and Postural Findings for CPIS

Vanderbilt ADHD Teacher Rating Scales Posture Intervention

	Teacher	Teacher	Change	-0+
Subject Number	Pre	Post		
F56P1	No Indicators	No Indicators	None	0
F56P2	CB3, CB4	CB1, CB3	No CB4, Added CB1	-1, +1
F56P3	Inattentive A1, A3, CB4, CB5	Inattentive A3, CB4, CB5	No A1	-1
F56P4	CB5	CB5	None	0
F56P5	Inattentive, Hyperactive/Impulsive A1, A3, CB1, CB2, CB3, CB4, CB5	Inattentive, Hyperactive/Impulsive A1, A3, CB1, CB3, CB4, CB5	No CB3	-1
F56P6	A2, CB4, CB5	A2, A3, CB4, CB5	Added A3	+1
F56P7	No Indicators	No Indicators	None	0
F56P8	Inattentive A2, A3, CB4, CB5	Inattentive A1, A2, A3, CB4, CB5	Added A1	+1
F56P9	No Indicators	No Indicators	None	0
F78P1	CB1, CB4, CB5	CB4, CB5	No CB1	-1
F78P2	No Indicators	No Indicators	None	0
F78P3	No Indicators	No Indicators	None	0
F78P4	Inattentive A3, CB4, CB5	A2	No Inattentive No A3, CB4, CB5 Add A2	-4, +1
F78P7	No Indicators	No Indicators	None	0
F78P8	No Indicators	A1, A3	Add A1, A3	+2
F78P9	A1	A1	None	0
F78P12	No Indicators	No Indicators	None	0
F78P13	No Indicators	No Indicators	None	0
F9P1	No Indicators	CB3	Add CB3	+1
F9P2	No Indicators	No Indicators	None	0
F9P3	A1	A2, A3	No A1 Add A2, A3	-1, +2
F9P5	CB2, CB3, CB4, CB5	CB2, CB4	No CB3, CB5	-2
F9P6	No Indicators	No Indicators	None	0
F9P7	No Indicators	No Indicators	None	0
F9P8	No Indicators	No Indicators	None	0
F9P9	A3	No Indicators	No A3	-1

F9P10	CB2, CB3	No Indicators	No CB2, CB3	-2
F9P11	No Indicators	No Indicators	None	0
F9P12	CB2, CB3, CB4	A3, CB2, CB4, CB5	No CB3 Add A3, CB5	-1, +2
F9P13	CB3	No Indicators	No CB3	-1
I5P1	No Indicators	No Indicators	None	0
I5P2	No Indicators	No Indicators	None	0
I5P5	A2, A3, CB4	No Indicators	No A2, A3, CB4	-3
I5P6	No Indicators	No Indicators	None	0
I5P7	No Indicators	No Indicators	None	0
I5P8	No Indicators	No Indicators	None	0
I5P9	No Indicators	No Indicators	None	0
I5P13	No Indicators	No Indicators	None	0
		N=38	Overall Number of Indicators changed	-8

Problematic Academic Performance:

A1 = Reading, A2 = Mathematics A3 = Written Expression

Problematic Classroom Behavior:

CB1 = Relationships with Peers, CB2 = Following Directions/Rules

CB3 = Disrupting Class, CB4 = Assignment Completion, CB5 = Organizational Skills

Vanderbilt ADHD Teacher Rating Scales Nutrition Intervention

	Teacher	Teacher	Change	- 0 +
Subject Number	Pre	Post		
I5N1	No Indicators	No Indicators	None	0
I5N3	No Indicators	No Indicators	None	0
I5N4	No Indicators	No Indicators	None	0
I5N5	No Indicators	No Indicators	None	0
I5N6	No Indicators	A1, A3	Add A1, A3	+2
I5N7	No Indicators	No Indicators	None	0
I5N8	A1, A3	A1, A3, CB4, CB5	Add CB4, CB5	+2
I5N9	No Indicators	No Indicators	None	0
I5N10	No Indicators	No Indicators	None	0
I5N11	CB1, CB4, CB5	CB1, CB5	No CB4	-1
I5N14	Inattentive, Hyperactive/Impulsive A1, A2, A3, CB3	Inattentive A2, A3	No Hyperactive /Impulsive A1, CB3	-3
I5N15	No Indicators	No Indicators	None	0
		N=12	Overall Number of Indicators changed	0

Problematic Academic Performance: A1= Reading, A2 = Mathematics A3 = Written Expression

Problematic Classroom Behavior:

CB1 = Relationships with Peers, CB2 = Following Directions/Rules

CB3 = Disrupting Class, CB4 = Assignment Completion, CB5 = Organizational Skills

Posture Intervention

Math Fluency

Subject	Pre	Post	Difference
F56P1	81	74*	-7
F56P2	72	73*	+1
F56P3	None	63*	n/a
F56P4	67	46*	-21
F56P5	43	23*	-20
F56P6	51	43*	-8
F56P7	100	110*	+10
F56P8	72	52*	-20
F56P9	63	59*	-4
F78P1	77	80	+3
F78P2	86	84*	-2
F78P3	74	53*	-21
F78P4	47	50*	-3
F78P7	99	108*	+9
F78P8	88	72*	-16
F78P9	82	None	n/a
F78P10	None	54	n/a
F78P12	74	58*	-16
F78P13	None	61	n/a
F9P1	94	109*	+15
F9P2	84	88	+4
F9P3	63	72	+9
F9P5	63	None	n/a
F9P6	77	84	+7
F9P7	83	98	+15
F9P8	70	None	n/a
F9P9	54	67	+13
F9P10	78	85	+7
F9P11	78	101*	+23
F9P12	87	92	+5
F9P13	106	102	-4
F9P14	None	55	n/a
I5P1	36	57*	+21
I5P2	32	63*	+31
I5P5	18	46*	+28
I5P6	49	58*	+9
I5P7	52	81	+29
I5P8	38	31	-7
I5P9	25	41*	+16
I5P13	39	59	+20

*Different math fluency test, started on the wrong side.

Nutrition Intervention

Math Fluency

Subject	Pre	Post	Difference
I5N1	44	54	+10
I5N2	Withdrew	Withdrew	
I5N3	51	62*	+11
I5N4	56	62	+6
I5N5	72	83	+11
I5N6	36	46	+10
I5N7	24	49*	+25
I5N8	34	40	+6
I5N9	37	44	+7
I5N10	56	67	+11
I5N11	41	42	+1
I5N12	No Score	No Score	
I5N14	44	48	+4
I5N15	52	65	+13

Posture Change Scores

Postural Experts	Rater 1	Rater 2	Rater 3	Avg. Rating	Rater 1	Rater 2	Rater 3	Avg. Rating
ID #	Standing	Standing	Standing	Standing	Sitting	Sitting	Sitting	Sitting
I5N1	-1	+1	+1	+1	+1	-1	+1	+1
I5N3	+1	+1	+1	+1	+1	-1	+1	+1
I5N4	+1	+1	+1	+1	+1	+1	+1	+1
I5N5	+1	+1	+1	+1	+1	+1	+1	+1
I5N6	0	-1	+1	0	+1	0	0	0
I5N7	+1	+1	+1	+1	+1	-1	-1	-1
I5N8	0	+1	0	0	0	+1	+1	+1
I5N9	+1	+1	+1	+1	+1	+1	0	+1
I5N10	+1	+1	+1	+1	+1	0	+1	+1
I5N14	0	+1	+1	+1	+1	-1	-1	-1
I5N15	+1	+1	+1	+1	0	-1	-1	-1
I5P1	-1	+1	+1	+1	+1	+1	+1	+1
I5P2	+1	+1	+1	+1	-1	0	+1	0
I5P5	0	+1	+1	+1	+1	+1	0	+1
I5P6	0	0	+1	0	+1	0	0	0
I5P7	+1	0	+1	+1	+1	-1	+1	+1
I5P8	+1	+1	+1	+1	-1	-1	-1	-1
F56P1	-1	-1	+1	-1	+1	+1	+1	+1
F56P2	+1	+1	+1	+1	0	+1	0	0
F56P3	+1	0	-1	0	+1	+1	-1	+1
F56P6	+1	0	+1	+1	+1	+1	+1	+1
F56P7	+1	+1	+1	+1	0	0	+1	0
F56P8	+1	+1	+1	+1	0	0	+1	0
F56P9	-1	+1	0	0	+1	+1	0	+1
F78P1	0	0	+1	0	+1	+1	+1	+1
F78P2	+1	0	+1	+1	+1	+1	+1	+1
F78P3	0	0	0	0	+1	+1	0	+1
F78P8	+1	0	0	0	+1	+1	+1	+1
F78P10	0	0	0	0	0	0	+1	0
F78P12	+1	0	0	0	+1	+1	+1	+1
F78P13	+1	+1	0	+1	0	0	+1	0
F9P1	+1	+1	+1	+1	0	0	+1	0
F9P2	+1	-1	-1	-1	+1	0	-1	0
F9P3	+1	+1	+1	+1	+1	+1	+1	+1
F9P6	+1	+1	+1	+1	+1	+1	+1	+1
F9P7	0	0	0	0	+1	+1	+1	+1
F9P9	+1	0	+1	+1	+1	+1	+1	+1
F9P10	+1	0	+1	+1	+1	+1	+1	+1

F9P12	+1	+1	+1	+1	+1	0	+1	+1
F9P13	+1	0	-1	0	+1	+1	+1	+1

- 1 Postural Alignment is worse, 0 No Change in Postural Alignment

+1 Postural Alignment is better

Appendix T

Student Open-Ended Comments

Comments: I really liked ...because 22/41

It was cool.

It helped me do well.

I liked Mrs. Healy coming in because it helps me gain sharper focus, and it's easier to lift heavy objects.

I like this posture class because it made me feel more relaxed than usual.

I can't sit with good posture.

I'm on the MSST the midnight sun swim team. Anything to swim faster and stronger.

It helped me sit up straighter.

After awhile it does feel better.

I got to learn about posture and it was interesting.

When I watch TV my mom always says "My why do you sit that tall, it looks uncomfortable?" I say, "No, it's a very comfortable pose." I was about 2 inches shorter now I am taller than my mom now. I thank-you very much.

It let me skip class time.

I learned new stuff through this.

I liked talking about how if you take care of your back now, you can have a strong healthy back in the future.

It made me think more about my future.

Made me more aware about how my dad was bending, and how to keep it strong.

I like this class because I go to a chiropractor and I've learned how important it is to have a straight and healthy spine.

Well, I learned more about the spine and what we can accomplish when we have good posture. Also the "drills" we were given of how to bend properly and etc.

I have noticed a difference in when I sit and I am starting to notice other people's posture and how they stand, sit, and walk.

I like the person teaching it.

I learned a lot of new facts.

They were interesting.

Watching the slide shows because some of the pictures were helpful.

I didn't like ... because comments 13/41

I didn't learn anything.

It didn't help me.

I like how I sit.

2- The computer... it got annoying.

At the start it was very uncomfortable.

I couldn't keep the stick on my back.

It took up my time for homework.

Can't really think of an excuse.

Hip hinging.

It was boring, I'm not into posture, and I don't like sticking my butt out.

Sitting and re-sitting, because it got tiring.

It was boring and I don't like posture, I think it's stupid.

Positive comments from *I didn't like ... because:* 6/41

I liked all that I was taught.

I actually enjoyed this study.

I liked it.

It was kind of annoying when the laptop reminded you every 10 minutes. Yet I got used to it and it was very helpful.

Nothing I didn't like.

It was fine!

Comments about liking postural alignment education 28/41 **68.29%**

Comments about not liking postural alignment education 13/41 **31.71%**

Appendix U

Responses to Student and Teacher Posture Follow-up Questions

Compiled Posture Study

Student Posture Follow-up Questions

What have you noticed about other people's posture?

Everything

How they stand.

More straight.

2-Yes, they/some are sitting tall!

They have improved a bit more.

Some people's posture has changed and others are the same.

They are mostly the same but sometimes I see someone sitting up a little straighter.

It has been better and their attention span.

That most people even in movies slouch, but in old movies more people sit up straight more.

Some people slouch a lot and some people sit tall.

Good.

Some people's posture is good.

And like one out of four people had good posture.

I now notice when someone is standing or sitting with good posture.

8-Their posture is poor/bad/not good.

Some sit slouched.

Mostly they slump.

They slouch a lot.

But they don't stand tall.

That some people need to work on theirs.

I have noticed some people when they pick something up and they bend their spine a lot.

That some people don't use their knees to bend.

9-Not much/not really/nothing.

How have you changed your posture?

2-Yes.

I've caught myself a couple of times and made my posture better.

I will straighten my back whenever I remember.

I've been keeping my neck straighter and then lifting objects while trying to keep my back straight.

By standing straight.

6- I have been sitting up tall/straight.

I sit taller, sometimes, because I don't want to have back problems.

When I sit down in a chair, and when I stand.

3-When I notice myself slouching I sit up straight.

When I am at home I hip hinge.

5-It's a little better.

Sometimes.

And Kind of

10-No, I don't think so.

I actually haven't really change posture.

I have not changed one bit.

What changes have you noticed in the way you interact with others?

A lot I discuss a lot more

2-I stand up straighter.

How well people's posture is.

On standing tall.

I can sit better than them.

They are all standing taller.

Well

Sometimes we get along great while sometimes we don't like each other.

2-I really haven't noticed that.

21-Nothing

I think I am the same.

They slump a lot.

How has your ability to focus changed?

It has become better.

2-It's good.

Yes.

Very much.

I am not so tired.

I am more focused.

Having good posture.

I am more awake than normal.

With a straight back, you want to pay attention more. I am not sure why

5-A little better

17-No, I haven't noticed anything.

I focus

I haven't realized the difference in being able to focus.

Good but bad.

I don't have to worry about if my back isn't straight.

How does your posture change when you are at home, school, or in the community?

It's good.

I stand or sit tall.

I've been sitting tall.

I actually sit straight.

It helps me walk and sit straight.

It helps get true tallness.
 By me catching myself at times.
 Done faster, run faster.
 When you are in more comfortable situations.
 I sit up a little straighter.
 I tried to sit up taller.
 At home I'm relaxed. Everywhere else is multiple positions.
 When I am grumpy, I don't care, but when I am happy, I really care.
 When people watch, I try to have good posture. When they don't, I don't.
 It stays about the same except at school, because we sit in chairs I tend to slouch more.
 At home I slouch a lot especially on the couch.
 At home relaxed, out in the city not as relaxed.
 I tend to get worse posture when I am at home.
 At home I'm relaxed, but at school I sit up sometimes.
 The "in crowd" stuff over the "fad" of the generation.
 Ha ha I taught my family some of the posture too It helped in a lot of ways
 13-It doesn't change at all.

What are your thoughts about your posture being affected by people or the environment?

I feel that I should stand up more straight.
 Sometimes they will notice how relaxed you look.
 If they sit up straighter, they're back won't get messed up as often.
 If they slouch, I stand or sit up straighter.
 I tried to stand taller.
 If it's good or they watch, it's better.
 That some people have a strong affect on others.
 The little computer sometimes reminded me.
 Helps people think that you're a good leader and they look up to you more.

I think if we see people with good posture we have better posture.

I agree.

Some people around kids that slouch a lot, and so they might want to do that because it looks cool.

It helps your posture by people saying something.

I(t) can happen.

4-I don't know?

I don't really think about it. I guess if you are surrounded by slouchers, you tend to slouch.

I forget sometimes to sit straight.

10-None.

I think the environment has nothing to do with it.

My posture isn't affected by people.

How does posture hurt the environment?

If you change your posture when you want to remember what people are saying, what are the changes you make to help you pay attention?

I changed how I stand.

Straighten my back, and sit tall.

I will push my shoulders back and stand on 2 feet, leveled evenly.

I straighten my back and focus on that person.

I might sit a bit taller though.

6-Sit up straight(er).

Shoulders back, back straight.

Shoulders and body straight.

Taller

Focus

Stand up straight.

I move my chair so I am facing them.

3-I don't know

13-No, I don't/nothing/none.

It doesn't help me pay attention.

Do you have any other thoughts on the posture lessons you would like to share?

25- No/Not really.

It's boring and dumb.

Sometimes when I'm not sitting straight my back hurts, but if I sit straight it feels better.

It was intriguing.

It was fun.

**Compiled Teacher Posture
Follow-up Questions**

What have you noticed about other people's posture?

That they are sloppy.

Not very good.

I noticed improper form more often, especially with pictures.

It varies. Young teen girls pooch their stomachs out. Boys slouch.

How have you changed your posture?

A little

I have been more conscientious about my posture.

Yes, I am more conscious about my posture since training (even though I already knew).

Attempt to sit straighter- no curve in spine.

What changes have you noticed in the way you interact with others?

Not sure

More eye contact.

I remind my class more often, but my interactions no changes.

None

How has your ability to focus changed?

I can focus better.

Unsure?

No.

A bit less tired.

How does your posture change when you are at home, school, or in the community?

I sit up straighter.

No response

I'm trying to keep good posture, not only first myself but for an example for my kids.

Attempt to work on it all 3 places.

What are your thoughts about your posture being affected by people or the environment?

No Response

Social norms.

My posture is a personal responsibility. However, others are a reminder, when I see bad posture I fixed mine.

Think poor posture is becoming an accepted norm in young and teens. Won't hip hinge because of way you must stick out your rear.

If you change your posture when you want to remember what people are saying, what are the changes you make to help you pay attention?

Stand Straighter

No response

I take notes if I want to remember, but I take note when sitting properly.

Standing- putting shoulders back. Sitting- erect

Do you have any other thoughts on the posture lessons you would like to share?

No response

No response

Should have been done first or second week of school. So we could set the expectation early, which we will from here on out.

Video reminder was good, but pictures no one has commented on as they did the video.

Bringing in a spying display was good. Visuals are always great.

I might add something regarding diet, because that affects posture also.

The evaluations were okay, but I didn't recall much of a change in behavior from before or after.

No response

Appendix V

Daily Exit Slip Student Responses

Day 1 Exit Slip:

What did you learn today?

To keep your back straight.

To have a good spine.

Spine is strong.

That your backs and spines are very strong.

The spine does a lot more than I thought it did.

You need to keep your back straight.

The system of the spine.

The parts of the spine.

I learned that you should stand straight up.

Many people do not know what they are doing to their spines. We need to stand and sit up straight.

Other countries have good posture.

That it is important to have good posture.

What good posture looks like.

Good posture.

The posture is important.

The need to have perfect balance in order to have good posture.

Posture is good for you.

3-About posture

That is a good thing to have good posture.

3-Hip hinging.

About hips and hip bending.

How to bend down properly.

We learned how to bend.

Bending downward with a straight back.

How to bend!

Hip hinging, how to bend down properly.

How to pick up things.

Hinge your hips.

That you can listen and get smarter if you sit right.

Sitting or standing straight can make you stronger.

That a guy can carry a lot of weight on its head if he keeps his spine right.

People can carry large amounts of weight if spine is in good posture.

I learned that if your posture is bad that you can damage your back.

I learned that posture is good for your body and health.

That it is bad to slouch.

What is wrong with postures.

2-Sit up.

Why do you think this is important?

Spine

Strong back

Posture

Sitting up.

So I can get better at school.

So that we can be stronger.

So we can have good posture.

So we become stronger.

So that you have good posture and use it straight and for your spine.

Because it helps you lift really heavy items when you get older.

Good for your health.

It is important to make your back straight so it will not hurt and it's more healthy.

So you don't be, hunchback of Notre Dame.

So I can carry stuff on my head.
So you don't think it's sensitive.
So your back could stay healthy.
Because we need good posture.
Because it is good for you.
Because back posture is very important for what ever you do.
So you will have your spine healthy for your whole life, also relieve stress.
To keep our backs healthy and strong as we all age.
So that you can maintain a healthy spine for your entire life.
So you can pick up more stuff and heavier things.
I think this is important so you can stay healthy.
Because you need your back to be able to work and move.
Because it helps the back pain.
To help my back.
It will help you live longer.
To keep a strong straight back.
People cannot work.
Because you could hurt yourself.
So that later on I won't have back problems.
So you don't screw your back up.
So you don't break your back.
Because if you have bad posture and you slouch a lot your spine might get stuck like that.
So your back does not hurt.
We may hurt ourselves by bending our spine wrong.
So you don't lose the use of your spine.
It can affect you when you get older.
2-It is not good to hunch.
They can be good models for us.
If you want to learn more about it when you grow up.

What questions do you have? What else do you want to know?

How long does your posture lasts when you get older?

How do you get 40% of your weight on your butt?

How can you tell if you have a straight back?

What does the death grip look like? (On the computer mouse)

When someone breaks his or her back, how does it look like when it heals?

Why do we need good posture?

What are the spines that stick out of the sides of the spine and what are they for?

Is it good to crack your back?

How do you fix a bad back?

Can posture affect your knees?

Can we feel the spine?

What would happen to your spine in if you've been back too much?

What if you are sleeping in your spine gets used to bending that way?

Day 2 Exit Slip:***What did you learn today?***

21-Sit up straight/right/properly/correctly.

To make your back flat when you're sitting.

Sitting is important.

You don't pop out your chest when you sit down.

I learned how to sit up without slouching.

The body is parallel so you can sit correctly.

How to stand straight.

2-How to keep good posture.

That if you keep good posture then your life will be happy.

That you breathe better when you sit up straight.

Sitting up can help you breathe better.

People in other countries have straighter backs. Try to sit up even if it is not comfortable.

To use your hip hinge.

Hip hinging helps.

To find our crease so we can bend.

Keep your back straight even when you're bending over.

5-Learning how to hinge your hip the right way.

To bend a little bit when you sit down.

Hip hinging and how to do it the right way.

Spinus process

My posture is fine-ish.

This can help me swim.

Why do you think this is important?

2-To breathe better/easier.

Because it helps you get more oxygen and blood flow through your body.

Helps with asthma.

Yes, because it helps you get more air and makes you look bigger.

Think better.

To pay attention.

To help your body.

It might help with health.

So you can pay more attention.

Looks nicer. Helps you feel more energetic.

So you can live long.

To help stay awake during the day.

Because it feels nice and I'll give you more energy.

Because it makes you more healthy and it is easier on your body.

So we can have a good spine.

So you can sit straight and relaxed.

2-So we can have good posture.

Because it affects how your posture is.

To keep your back in place.

So you can have a stronger spine and knees.

To keep your back in line.

To help your back.

So your spine can move.

To have a straight spine.

If bad posture does not have an immediate effect on you while you're young then it will affect you when you are old.

You will get an arc when you're old.

2-So you don't hurt your back.

3-So you don't break your back.

Because it helps you not to bend (hunch) your back.

2-You don't strain your back.

So we don't hurt ourselves.

2-So you don't fall out of the chair.

Hinging your hips the right way can keep your knees healthy.

I'm on the MSST team!

What questions do you have? What else do you want to know?

Would this affect your overall strength?

If you have a hunchback would you be able to fix it?

Why do some native Chinese people have good posture but some Americans don't?

Why should you use your hip hinge?

If you had a disk blown out of your back what would it look?

Is it good to wear a brace on your back to help you get your back into place and keep good posture?

What complications can sitting improperly cause?

3-Is it bad if you crack your back? How will your spine react?

Do different shoes make your spine different when we walk?

Day 3 Exit Slip:

What did you learn today?

20-I learned about (how to) standing properly/straight/tall.

Standing tall is important.

2-I learned about posture.

2-How to find your back alignment.

How to check our alignment.

How to correctly bend.

4-I learned about sitting properly.

2-To sit tall.

I learned to not sit back.

That if you push your hips forward together back that looks weird.

When you stand you want to keep your back, hips and shoulders in a straight line.

That I used to lean forward.

Most of your weight is carried in your spine.

That you won't be so tired if your back is straight.

Understand better.

Not to bend your spine.

Why do you think this is important?

3-To stand tall.

2-To have/keep good posture/back.

So you can maintain good posture.

You keep your spinal cord in place.

So you can stand straight and sit straight.

To help your back.

Spine.

To keep your balance.

Better posture and balance.

It helps with your posture and you're not so tired.
 To build up muscles in your back.
 Because it helps get more blood everywhere and makes you look tall.
 Because when you have good posture it brings more blood to your brain.
 It brings more blood flow to your brain.
 How to feel 110%.
 So we can be in good shape when we're older.
 So you can walk.
 So your bones stay straight.
 So you don't have a hunch on your back.
 Because it helps keep no bump.
 So that way you don't look like a question mark.
 It helps keep your back alignment and prevent your back from hurting.
 Because then you will not have a bad back.
 You won't get a hernia is easy.
 So you don't have bad posture.
 So you don't lock your knees and fall and hurt.
 So you do not go over.
 If it becomes a habit then it's hard to break.
 It takes some strain off your muscles.
 So that you don't blow it disc or something
 No popped spine.
 You don't kill your back.
 How not to be in pain.
 So you don't get knee or hip surgery.
 To correct it.

What questions do you have? What else do you want to know?

Why is it so important to sit up straight?

Why does my back dip?

I want to know should we eat good, does it help?

Will IDD therapy Accu Spina help get bulging discs retract back into the spine?

How do we get in good position if you're in a bad position?

If you have a broken back can it heal?

How long does it take to develop a popped spine?

How could you prepare to stand tall?

Could having bad posture affect your sports play?

Does lying on your stomach when you sleep affect your posture?

How does our spine bend?

If the heel is higher in the shoe, does that help or not?

If the heel is lower in the shoe, does that help or not?

How do you break your back?

How can you have good posture?

Why are bones hard?

How do you break your back?

Why do you have to hit hinge when you sit and re-sit? Why do we have to have our feet on the ground?

Day 4 Exit Slip:***What did you learn today?***

35-To walk better/right/tall/straight/correct/good/proper posture.

Lean forward when you walk.

How to walk forward and backward.

2-Walking is healthy and important.

It looks cool to walk with a straight back.

I learned how to run.

To stand tall.

Posture

Why do you think this is important?

So you could stand right up.

4-To keep your spine straight/good posture.

It is better for your sacrum.

5-So we can walk well/better.

It will help your balance when you walk.

To improve your health.

It will help me to lead a healthier and possibly a more productive life.

Because the better posture you have the better you'll be.

Helps you take bigger steps.

Walk faster.

Walking in the right way properly let's you have a great posture.

So you're healthy and you look nice when walking.

Walking in the right way let you not waste as much time and get better posture.

It helps your spine.

Because you're taller and you'll get more air!

So you can play sports better.

Better back.

So you can have good posture in old age.
 Because we walk every day.
 To not be a slumped old person.
 So you don't look old.
 So you don't look like a lollipop.
 So that way you don't get bad posture.
 For good posture and your back won't hurt as much.
 2-So you don't get hurt.
 So you don't forget.
 Because.
 I don't know.
 So you do not walk. I am silly.

What questions do you have? What else do you want to know?

Will this help me swim faster?
 Do those proper posture help your health?
 Can your spine arc when you walk?
 How many back vertebrates are there?
 What if we broke one of our legs and we were able to walk that well?
 How would you run with a straight-backed?
 Could having bad posture affect your knees?
 Does having a lot of weight on your back affect your back? (When you're carrying something on your shoulders)
 Did the gangsters like Al Capone walked straight back?
 Why did our posture deteriorate over time?
 How come in foreign countries they have good posture and in America we have bad posture?
 Does it hurt to crack your back?
 Are other animals considered to have good or bad posture?

Are we good at posture?

Day 5 Exit Slip:

What did you learn today?

11-To remember to do our posture right.

That if you check other's posture, you remember your own.

9-Review.

How to sit, walk, and stand.

2-Sit up straight.

Not slouching can actually help all your internal organs work better.

2-How it affects your insides when you don't have good posture.

Keep a straight back and you can breathe better.

I learned about the spine and the interlocking vertebrae's and sacrum.

Why do you think this is important?

In every way.

2-It keeps you in balance.

8-To keep good posture.

To help you keep you interested with your posture.

Because I can improve my posture.

Helps improve your posture.

6-It is important to stand straight/tall.

3-It helps you to stay healthy.

It can give you more energy and help you feel more energetic.

So we can do good in school.

Because we need to be straight.

For healthy strong bones.

To lift heavy stuff.

For blood flow.

So you can walk.

So you can maintain a healthy spine.

7-It was a review of all the things we've learned so we remember.

We went over walking in sitting.

How to sit, stand, and walk!

Bending.

Properly bend and push.

That fashion impacts our posture.

So that the right amount of blood flowing is moving smoothly and so that we won't have back problems when get older.

So you don't break your back.

So we don't hurt ourselves.

So you don't hurt your back.

Because it can hurt you.

So you don't get asthma.

My organs could quit.

I don't know.

What questions do you have? What else do you want to know?

If you walk like this (Stick figure drawing of a person leaning way back as they walk)
would you be able to fix it?

If you didn't hip hinge could you keep good posture?

What if you forget how to walk?

If you are paralyzed will it make your posture better the same or worse?

Does everybody have the same kind of spine?

Can you teach us in sixth grade?